**National Park Service**
**U.S. Department of the Interior**

**Saguaro National Park**
**Arizona**

# Exotic Plant Management Plan Environmental Assessment

## November 2004

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# Environmental Assessment

**November 2004**

# Exotic Plant Management Plan

**Saguaro National Park • Arizona**


## SUMMARY

Exotic plants infest approximately 2.6 million acres in the national park system, reducing the natural diversity these places were set aside to protect. At Saguaro National Park, the National Park Service proposes to use a proactive, integrated approach to manage exotic plant infestations.

This environmental assessment examines in detail two alternatives: no action and the National Park Service preferred alternative. The preferred alternative includes the use of mechanical, cultural, chemical, low risk, and biological control techniques. Currently, there are 80 exotic plant species found within the park. This plan proposes to treat 17 of these species immediately because they are invasive, aggressive, and displace native vegetation. The remaining species may be treated in future years if time, funding, and scientific knowledge allow. The environmental consequences of each of these alternatives were evaluated. The impacts to natural resources (soils, vegetation, wildlife, special-status species, and water quality and quantity), cultural resources (archeological resources and historic structures), wilderness, and human health and safety were analyzed.


## PUBLIC COMMENT

If you wish to comment on the environmental assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days; comments are due by December 13, 2004. Please note that names and addresses of people who comment become part of the public record. **If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment.** We will make all submissions from organizations, businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

**Please address comments to:**
Superintendent, Attn: Exotic Plant Management Plan, Saguaro National Park, 3693 S. Old Spanish Trail, Tucson, AZ 85730.

Email: SAGU_Planning@nps.gov

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# CHAPTER 1 - PURPOSE AND NEED

This Environmental Assessment (EA) is prepared in accordance with regulations of the Council on Environmental Policy Act (CEQ) (40 CFR 1500 et seq.) and part 516 of the U.S. Department of the Interior's Departmental Manual (516 DM). The National Environmental Policy Act (NEPA) is the basic national charter for environmental protection; among other actions it calls for examination of impacts on components of affected ecosystems. Section 106 of the National Historic Preservation Act of 1966 (as amended through 2000) mandates that Federal agencies take into account the effects of their actions on properties listed or eligible for listing in the National Register. Saguaro National Park is developing a Programmatic Agreement in conjunction with this EA to meet its obligations for NEPA and under Section 106, in accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 (36 CFR 800.8, *Coordination With the National Environmental Policy Act*).

This EA discloses the planning and decision-making process and the potential environmental consequences of the alternatives. The analysis of environmental consequences was prepared to adequately understand the consequences of the impacts of the proposed action and to involve the public and other agencies in the decision-making process. In implementing this proposal, the NPS will comply with all applicable laws and executive orders. Appropriate federal, state, and local agencies have been contacted for input, review, and permitting in coordination with legislative and executive requirements.

## PURPOSE

Non-native invasive plant species seriously threaten the structure and function of these ecosystems. Saguaro National Park proposes to use an integrated approach to eradicate, contain, control, and prevent non-native plants within the park. The active management of these plants will promote the ecosystem health of the park's diverse communities by maintaining or improving native forb, grass, shrub, tree, cactus, and succulent species, and ultimately preventing the loss of wildlife habitat. The purpose of this environmental assessment is to present and analyze alternatives for managing and controlling exotic plant species within the park.

Saguaro National Park (Figure 1) contains within its boundaries natural and cultural resources that are typical of and represent the Sonoran Desert in southern Arizona. The portion of the park now known as the Rincon Mountain District (RMD) was established as a national monument by presidential proclamation (No. 2032) on March 1, 1933. This proclamation states that the purpose of "reserving [the] land…as a national monument" was to preserve and protect "…the exceptional growth thereon of various species of cacti, including the so-called giant [saguaro] cactus." On November 15, 1961, Presidential Proclamation No. 3439 added lands in the Tucson Mountains to the Monument. A first enlargement of the Tucson Mountain District (TMD) occurred on October 21, 1976 (PL 94-578). Preservation of wilderness values was legislatively mandated on October 20, 1976 (PL 94-576), when 13,470 acres in the TMD and 57,930 acres in the RMD were formally designated as wilderness in accordance with the provisions of the Wilderness Act. In 1991, PL 102-61 expanded the boundaries of the RMD to include lands in the Rincon Valley. In 1994, legislation (PL 103-364) was signed into law that

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# Figure 1

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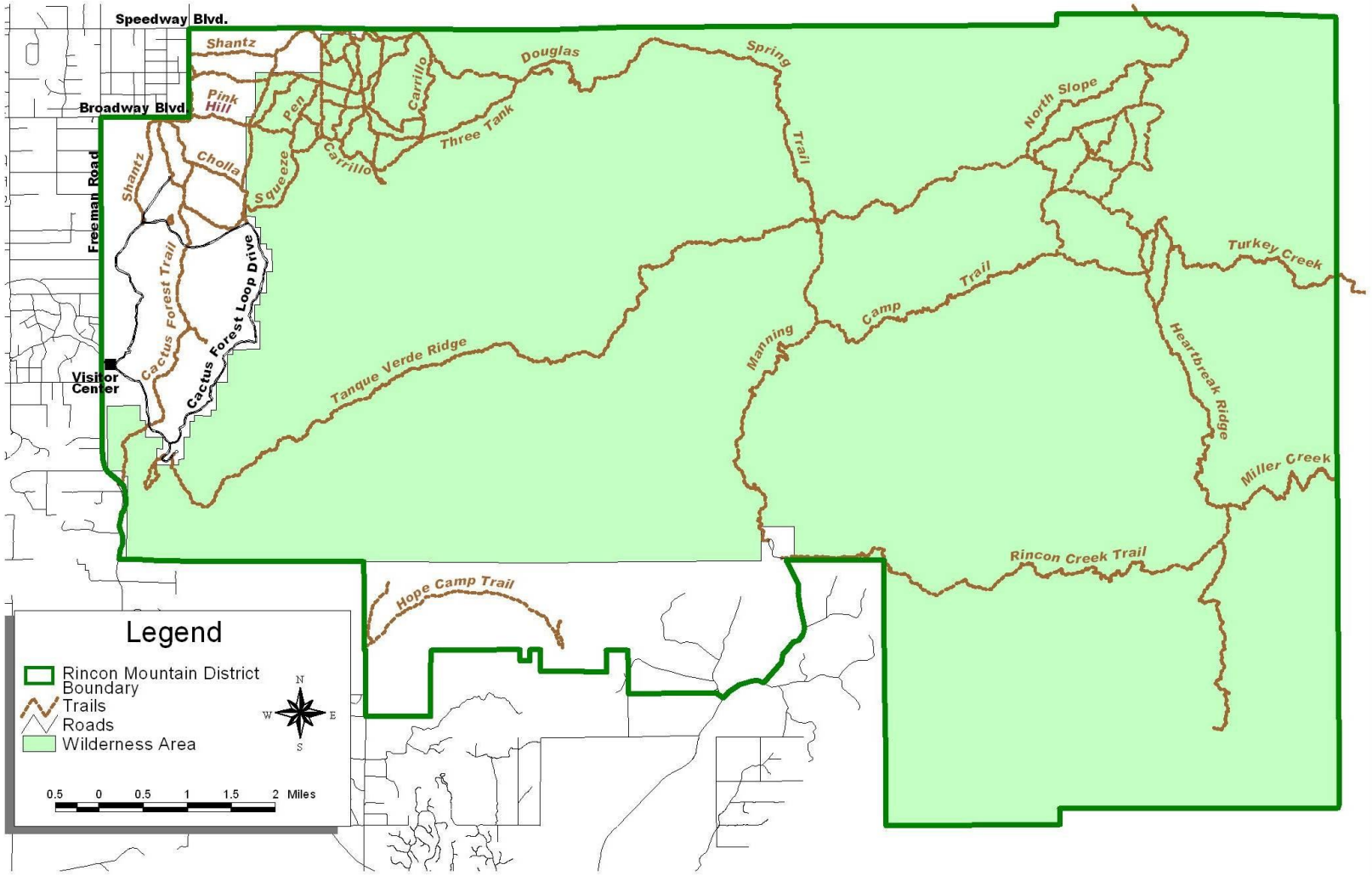
## Rincon Mountain District




Data Sources: Saguaro National Park

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# Figure 1

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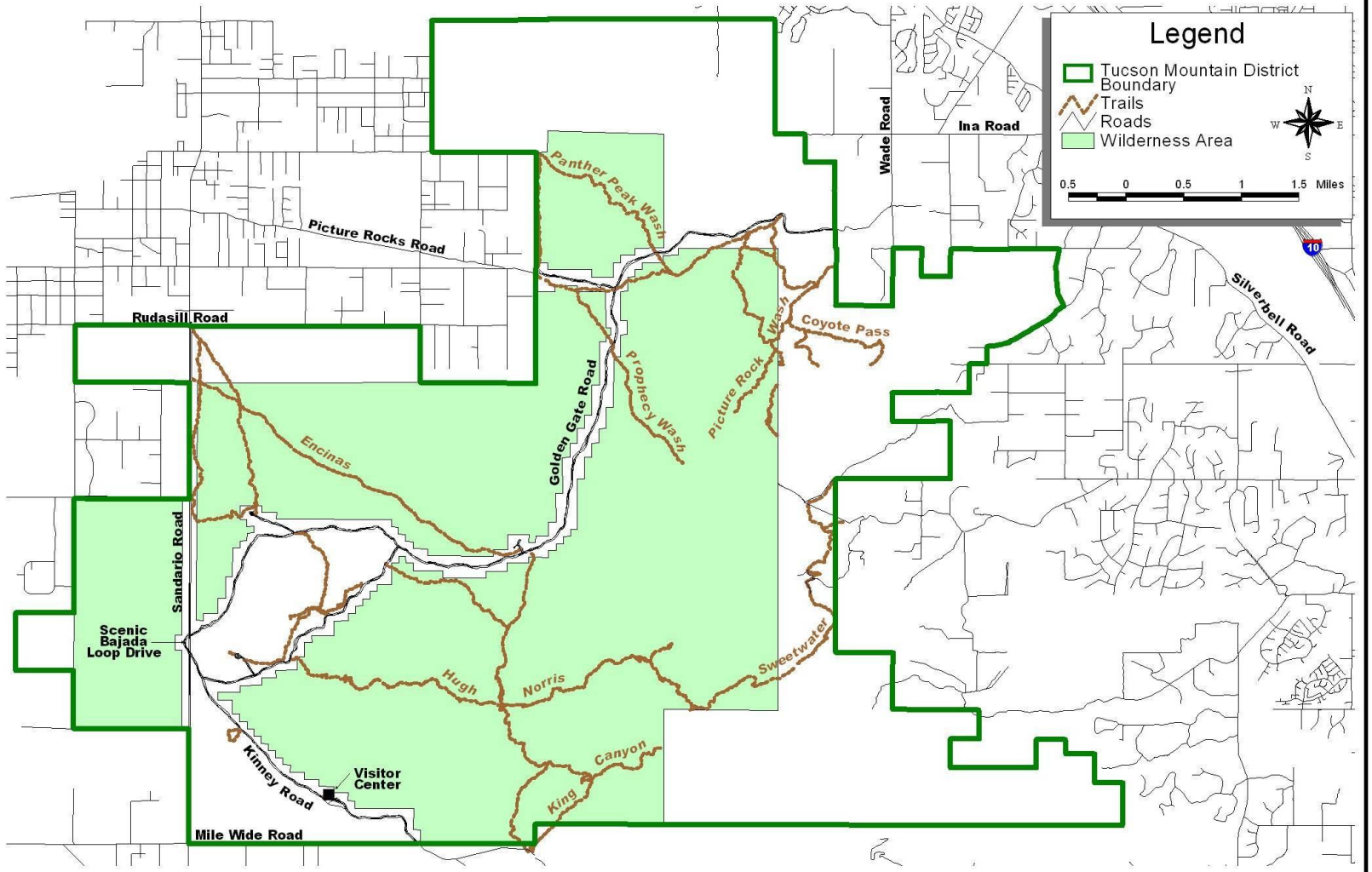
## Tucson Mountain District




Data Sources: Saguaro National Park

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enlarged the boundaries of the monument and changed Saguaro from a national monument to a national park (NPS 1995). Saguaro National Park is currently 91,446 acres.

Both units of the park are located in Pima County, Arizona, and are separated by the city of Tucson. The TMD is located on the western edge of the city and is bordered primarily by Tucson Mountain Park on the south, and residential development on the north, east, and west. The RMD is located on the eastern edge of the city, approximately 30 miles east of the TMD, and is bordered on the east and portions of the north and south sides by the Coronado National Forest, Santa Catalina Ranger District. Residential developments border sections of the western, southwestern, and northwestern boundaries of this district. The park ranges in elevation from 2,180 feet (TMD) to 8,666 feet (RMD) and encompasses six structurally distinct biotic communities.

The significance of Saguaro National Park lies in the rich diversity of Sonoran Desert life found within a framework of historic and prehistoric human occupation. Park management must assure that these natural and cultural resources are managed in such a manner as would leave them unimpaired for the enjoyment of future generations.

The park's purpose statements include:

- Preserve and protect the saguaro cactus and the diverse vegetation and wildlife habitat of the surrounding Sonoran Desert.
- Preserve and protect the mountain and riparian habitats associated with the Sonoran Desert in the Tucson and Rincon Mountains.
- Preserve and protect wilderness qualities such as solitude, natural quiet, scenic vistas, and natural conditions.
- Promote understanding and stewardship of the park's natural and cultural resources through appropriate scientific study.
- Provide opportunities to understand and enjoy Saguaro National Park in a manner that is compatible with the preservation of park resources and wilderness character (NPS 2003a).

National Parks represent complex communities of native plants and animals that have developed over thousands of years. Non-native invasive plant species seriously threaten the structure and function of these ecosystems. Saguaro National Park proposes to eradicate, contain, control, and prevent non-native plants within the park. The desired goals are to:

- Prevent any new exotic species from becoming established.
- Immediately treat any new infestations of the 13 species previously found in and currently eradicated from the park.
- Eradicate 17 species which are the most invasive and pose the greatest threat to the biological diversity within the park.
- Eradicate, contain, or control the spread of 63 known invasive species in future years as time, funding, and scientific knowledge allow.

The active management of these plants will promote the ecosystem health of the park's diverse communities by maintaining or improving native forb, grass, shrub, tree, cactus, and succulent species, and ultimately preventing the loss of wildlife habitat. The purpose of this environmental assessment is to present and analyze alternatives for managing and controlling exotic plant species within the park.

A second purpose of this EA is to determine the appropriate minimum requirements for accomplishing this project in the park's wilderness based on the best available scientific knowledge.

# NEED

Controlling exotic plant infestations at Saguaro National Park is one of the most serious challenges facing park managers, who are charged with the protection of natural and cultural resources. Currently there is not a planning document that outlines how to manage exotic plants. The park has completed exotic plant surveys and has started mechanical control of invasive exotic plant species, but lacks a comprehensive plan for exotic plant management.

Out of the approximately 1,200 plant species found at Saguaro, 80 species are not native to this region. Of these, 17 species are of particular concern because they are aggressive, invasive, and have the potential to displace or hybridize with native plants. These species are a threat to the park's natural resources. For example, buffelgrass (*Pennisetum ciliare*) has been shown to have high fuel loads (Haines et al. i*n prep*), which is a concern because fire does not naturally occur in the Sonoran Upland and could result in local extirpation of distinctive species that are not adapted to fire (Esque et al. 2004, Búrquez-Montijo et al. 2002, Rogers 1985). Eradication or control of invasive exotic species is critical to protect and maintain the natural and cultural resources that are the focus of the park's purpose.

The Restoration Program has taken limited action on some of the species listed in Table 1; other exotic plant species (Table 2) in the park are monitored and may be added to the species to control list in the future. Control efforts have been completed in the past with the use of a categorical exclusion (for NEPA compliance), but due to the expanding scope and nature of the control effort, an environmental assessment is now needed.

Exotic plants have been identified as a threat to biotic communities in Pima County by the Sonoran Desert Conservation Plan (SDCP, Huckelberry 2000). This plan recognizes the need to preserve native biodiversity and has developed a science-based map that identifies high priority areas for biological and cultural conservation (Huckelberry 2002). In addition, during the SDCP development, two documents addressing the issue of exotic plants were produced; one discusses issues of exotic plant species in public reserves, including Saguaro NP (Connolly 2000), and the other describes ecological effects and management strategies for potentially problematic species (Kingsley 2000). Saguaro NP is within the Conservation Land System (CLS) developed by the SDCP (Huckelberry 2002). The park has supported and participated in the development of the SDCP; and the development and implementation of an Exotic Management Plan at Saguaro NP would be consistent with its objectives. This action would also be in concert with federal policies and regulations, as well as with long-term planning and conservation efforts in the region.

**Table 1. Species that have been treated previously in the park and/or will be considered species to treat in the first three years of the Exotic Plant Management Plan.**

The treatment methods listed below are for reference and the park may use one or more of the known treatment methods for a species, dependent on factors described in Chapters 2 and 3.

***** = park has taken limited action on these species in the past

| Exotic plant species | Growth habit | Known treatment methods |
|---|---|---|
| *Avena fatua** wild oats | Annual, cool-season grass spread by seed; observed to have strong allelopathic effects in some areas. | Hand/tool pulling. Effective herbicide is glyphosate. Plants and seeds destroyed by fire. |
| *Brassica tournefortii** Sahara mustard | Winter annual herbaceous species. | Hand pull plants in small infestations. Effective herbicides include glyphosate, 2,4-D, dicamba, triclopyr. Repeat pulling and/or |

| Exotic plant species | Growth habit | Known treatment methods |
|---|---|---|
| | | herbicide use as necessary to prevent re-establishment. |
| *Caesalpinia gilliesii*<br>Mexican bird-of-paradise | Perennial, showy leguminous shrub. A common landscape plant in Tucson. | Manual digging should be an effective control method. |
| *Cenchrus longispinus*<br>longspine sandbur | Annual grass. | Mechanical treatment if small population. Consider herbicide use if pulling causes too much soil disturbance or is ineffective. |
| *Centaurea melitensis**<br>Malta starthistle | Winter annual herbaceous species; prolific seed productions; spreads rapidly. Small seed head formed in the center of rosettes makes mowing ineffective. Viable seed can be produced within eight days of flowering. | Mechanical treatment to completely remove plant and root, then burn to destroy seeds. If area is too large for effective hand pulling, spot applied herbicides. Effective herbicides are picloram, dicamba, 2,4-D, clopyralid, and glyphosate. Ensure good stand of native species; revegetate if necessary. |
| *Convolvulus arvensis*<br>field bindweed | Perennial vine. Has a deep, extensive root system and long-lived seeds. | Manual control may be effective if aboveground biomass is consistently removed for several seasons. Successful eradication may take 5 or more years of treatments. Effective herbicides include glyphosate, 2,4-D, and dicamba. |
| *Cortaderia selloana*<br>pampas grass | Vigorous, perennial tussock-forming grass that produces large amounts of above and below ground biomass, as well as huge amounts of wind-dispersed seeds. | Manual removal is labor intensive (root crown must be removed to prevent resprouting), but is the preferred control method for small infestations. Glyphosate is a possible herbicide but is apparently untested. |
| *Dimorphotheca sinuata**<br>African daisy | Annual herbaceous weed (composite). | Mechanical treatment (all populations found to date have been small and easily controlled). |
| *Eragrostis cilianensis**<br>stinkgrass | Annual, warm-season grass reproducing by seeds. | Hoe seedlings as recognizable. Small infestations can be hand-pulled when young. |
| *Eragrostis curvula* var. *conferta*, *Eragrostis curvula**<br>Boer lovegrass, weeping lovegrass | Perennial warm-season bunchgrasses, reproducing by seeds. | One project (VA, USA) saw success with manual removal (including root system) followed by spring burning. Potential herbicides include glyphosate. |
| *Eragrostis lehmanniana**<br>Lehmann's lovegrass | Perennial, aggressive warm-season bunchgrass spread rapidly by seed. | If found in small populations, hand pull or treat with herbicide (glyphosate, metsulfuron methyl or imazapic) and revegetate as needed. Mowing may help in combination with herbicide application. |
| *Malva parviflora**<br>little mallow | Annual/biennial/short-lived perennial herbaceous species reproducing by seed. Can flower almost year-round; produces long, tough taproot. | Young plants can be hand-pulled or treated with glyphosate before taproot develops. |

| Exotic plant species | Growth habit | Known treatment methods |
|---|---|---|
| *Marrubium vulgare** horehound | Cool season, perennial herb reproducing by seed. Successful invader of degraded areas. | Hand pull/hoe small infestations before seed set. Fire kills mature plants and reduces seed bank, and can be effective with follow-up treatment of post-fire germination. Potential herbicides include 2,4-D. Biological controls (2 species of moths) have been used in Australia. Revegetate if necessary. |
| *Medicago polymorpha* bur clover | Annual vine or forb. | Hand-pulling may be an effective method of control. |
| *Nerium oleander** oleander | Woody shrub. | No documentation of previous control efforts has been found, but because of similarity to other species, cut-surface application of herbicide (triclopyr) may be recommended. Follow-up treatments may be necessary. |
| *Opuntia engelmannii* var. *linguiformis** cow's tongue prickly pear | Cactus native to central Texas, hybridizes with other *Opuntia* species. | Mechanical treatment. |
| *Pennisetum ciliare** buffelgrass | Perennial grass with moderate spread by seed and slow spread vegetatively. | Mechanical treatment (hand/tool pulling) for very small populations (<25 plants). Effective herbicides are triclopyr and glyphosate. Repeat pulling and/or herbicide use as necessary to prevent re-establishment. |
| *Pennisetum setaceum** fountain grass | Perennial grass with moderate spread by seed; generally does not spread vegetatively, but there are non-seed producing cultivars. | Hand/tool pulling for very small populations (<25 plants). Effective herbicides are 2,4-D, triclopyr, glyphosate. Repeat pulling and/or herbicide use as necessary to prevent re-establishment. |
| *Rhus lancea** African sumac | Tree or woody shrub. Can sprout from roots, cut stumps. | No documentation of previous control efforts has been found, but because of similarity to other species, cut-surface application of herbicide (triclopyr) may be recommended. Follow-up treatments may be necessary. |
| *Salsola* spp.* Russian thistle, tumbleweed | Annual, warm-season herbaceous weed of disturbed areas. Prolific seed producer. | Consider treatment only if area will be continually disturbed by natural processes. Consider herbicide use (glyphosate) if pulling causes too much soil disturbance or is ineffective. Ensure good stand of native species; revegetate if necessary. |
| *Sisymbrium irio** London rocket | Cool season (in Arizona) annual herbaceous species; prolific seed producer. | Effective herbicides are 2,4-D, glyphosate. |
| *Sonchus* spp.* | Semi-succulent winter annual | Hand-pull plants in small |

| Exotic plant species | Growth habit | Known treatment methods |
|---|---|---|
| sowthistle | species. Reproduces only from seeds. Generally restricted to disturbed sites. | populations, ensuring complete removal of taproot. Consider herbicide use (glyphosate, 2,4-D, clopyralid, dicamba, picloram) if pulling causes too much soil disturbance or is ineffective. Biological control (gall-forming insect) has been approved in Canada. |
| *Sorghum halepense** Johnson grass | Perennial, warm-season rhizomatous grass; aggressive and adaptable. Spreads rapidly by seed and from rhizomes, primarily in moist areas. | Hand-pull plants in small populations. Consider herbicide use (e.g. glyphosate labeled for riparian use) if pulling causes too much soil disturbance or is ineffective. Herbicide use will require careful timing and repeated treatment. Resistant to fire. |
| *Tamarix* spp.* Tamarisk, salt cedar | Woody deciduous shrubs or trees; reproducing by seed and vegetatively by layering, sprouting and from root fragments; prolific seed production. *T. aphylla* is an evergreen species that reproduces generally only vegetatively and may be less invasive. | Cut-surface application of herbicide (triclopyr). Follow-up treatments may be necessary. Biological controls are under development in the US. |
| *Tribulus terrestris* puncturevine, goatshead | Summer annual, prostrate weed, reproduces from seed. Can potentially spread very rapidly. Can be confused with native *Kallstroemia* species. | Hand-pulling and/or repeated hoeing/cultivation of plants in small infestations. Most effective herbicides include dicamba, picloram, and glyphosate. |

**See Appendix E for citations and further information on these and additional exotic species.**

## Table 2. Exotic Plants of Saguaro National Park (present and potential).

□ = Historic but currently eradicated from the park.
▲ = Proposed for immediate control (within first three years of plan)
◊ = Proposed for potential control before the sunset date of this plan

| Exotic species | Present in the park | Proposed for treatment | State listed* |
|---|---|---|---|
| *Agrostis semiverticillata* beardless rabbitsfoot grass | ■ | ◊ | |
| *Agrostis stolonifera* var. *palustris* creeping bentgrass | ■ | ◊ | |
| *Ailanthus altissima* tree of heaven | | ◊ | |
| *Alhagi pseudalhagi* camelthorn | | ◊ | ■ |
| *Arundo donax* giant cane | □ | ◊ | |
| *Avena fatua* wild oats | ■ | ▲ | |

| Exotic species | Present in the park | Proposed for treatment | State listed* |
|---|---|---|---|
| *Avena sativa*<br>common oat | □ | ◊ | |
| *Brassica tournefortii*<br>Saharan mustard | ■ | ▲ | |
| *Bromus diandrus*<br>ripgut grass | | ◊ | |
| *Bromus rubens*<br>red brome | ■ | ◊ | |
| *Bromus tectorum*<br>cheatgrass | □ | ◊ | |
| *Caesalpinia gilliesii*<br>Mexican bird-of-paradise | ■ | ▲ | |
| *Capsella bursa-pastoris*<br>shepherd's purse | ■ | ◊ | |
| *Cenchrus longispinus*<br>longspine sandbur | ■ | ▲ | ■ |
| *Centaurea melitensis*<br>Malta starthistle | ■ | ▲ | |
| *Centaurea solstitialis*<br>yellow starthistle | | ◊ | ■ |
| *Cerastium gracile*<br>slender chickweed | ■ | ◊ | |
| *Chenopodium graveolens* var. *neomexicanum*<br>fetid goosefoot | ■ | ◊ | |
| *Chenopodium murale*<br>lambsquarter | ■ | ◊ | |
| *Cirsium arvense*<br>Canada thistle | | ◊ | ■ |
| *Cirsium vulgare*<br>bull thistle | | ◊ | |
| *Citrullis vulgaris*<br>watermelon | □ | ◊ | |
| *Convolvulus arvensis*<br>field bindweed | ■ | ▲ | ■ |
| *Cortaderia selloana*<br>pampas grass | ■ | ▲ | |
| *Cynodon dactylon*<br>Bermuda grass | ■ | ◊ | |
| *Dactyloctenium aegyptium*<br>Egyptian grass | ■ | ◊ | |
| *Digitaria ciliaris*<br>southern crabgrass | ■ | ◊ | |
| *Digitaria sanguinalis*<br>hairy crabgrass | ■ | ◊ | |
| *Dimorphotheca sinuata*<br>African daisy | □ | ◊ | |
| *Echinochloa* sp.<br>jungle ricegrass, barnyard grass | ■ | ◊ | |
| *Eragrostis cilianensis*<br>stink grass | ■ | ◊ | |
| *Eragrostis curvula* var. *conferta*<br>weeping lovegrass | ■ | ◊ | |

| **Exotic species** | **Present in the park** | **Proposed for treatment** | **State listed*** |
|---|---|---|---|
| *Eragrostis echinochloidea*<br>lovegrass | ■ | ◊ | |
| *Eragrostis lehmanniana*<br>Lehmann lovegrass | ■ | ◊ | |
| *Erodium cicutarium*<br>redstem filaree | ■ | ◊ | |
| *Euphorbia esula*<br>leafy spurge | | ◊ | ■ |
| *Euryops subcarnosus*<br>sweet resinbush | | ◊ | |
| *Galium aparine*<br>bedstraw | ■ | ◊ | |
| *Hedyotis crassifolia*<br>southern bluet | ■ | ◊ | |
| *Herniaria hirsuta* ssp. *cinerea*<br>hairy rupturewort | ■ | ◊ | |
| *Hordeum murinum* ssp. *glaucum*<br>wild barley | ■ | ◊ | |
| *Lactuca serriola*<br>prickly lettuce | ■ | ◊ | |
| *Lamarckia aurea*<br>goldentop grass | ■ | ◊ | |
| *Linum grandiflorum*<br>flax | □ | ◊ | |
| *Malva parviflora*<br>cheeseweed | □ | ◊ | |
| *Marrubium vulgare*<br>horehound | ■ | ▲ | |
| *Matthiola longipetala* var. *bicornis*<br>evening stock | ■ | ◊ | |
| *Medicago polymorpha*<br>bur clover | ■ | ▲ | ■ |
| *Medicago sativa*<br>alfalfa | ■ | ◊ | |
| *Melilotus* sp.<br>sweetclover | ■ | ◊ | |
| *Mollugo cerviana*<br>seringe | ■ | ◊ | |
| *Nerium oleander*<br>oleander | ■ | ▲ | |
| *Nicotiana glauca*<br>tree tobacco | □ | ◊ | |
| *Opuntia lindheimeri* var. *linguiformis*<br>cow's tongue prickly pear | □ | ▲ | |
| *Opuntia santa-rita*<br>Santa Rita prickly pear | □ | ◊ | |
| *Oxalis stricta*<br>yellow woodsorrel | ■ | ◊ | |
| *Panicum antidotale*<br>blue panicgrass | ■ | ◊ | |
| *Papaver* sp.<br>ornamental poppy | □ | ◊ | |

| Exotic species | Present in the park | Proposed for treatment | State listed* |
|---|---|---|---|
| *Paspalum dilatatum*<br>dallisgrass | ■ | ◊ | |
| *Pennisetum ciliare*<br>buffelgrass | ■ | ▲ | |
| *Pennisetum setaceum*<br>fountain grass | ■ | ▲ | |
| *Pentzia incana*<br>pentzia | | ◊ | |
| *Phalaris* sp.<br>canarygrass | ■ | ◊ | |
| *Phleum pratense*<br>timothy | ■ | ◊ | |
| *Poa annua*<br>annual bluegrass | ■ | ◊ | |
| *Poa pratensis*<br>Kentucky bluegrass | ■ | ◊ | |
| *Polygonum aviculare*<br>prostrate knotweed | ■ | ◊ | |
| *Polypogon monspeliensis*<br>rabbit foot grass | ■ | ◊ | |
| *Rhus lancea*<br>African sumac | ■ | ▲ | ■ |
| *Rhynchelytrum repens*<br>natal grass | ■ | ◊ | |
| *Rumex acetosella*<br>sheep sorrel | ■ | ◊ | |
| *Rumex crispus*<br>curly dock | ■ | ◊ | |
| *Salsola* spp.<br>Russian thistle | ■ | ◊ | |
| *Schismus arabicus, S. barbatus*<br>Mediterranean grass | ■ | ◊ | |
| *Sisymbrium altissimum*<br>tumblemustard | ■ | ◊ | |
| *Sisymbrium irio*<br>London rocket | ■ | ◊ | |
| *Sonchus asper, S. oleraceus*<br>sow thistle | ■ | ◊ | |
| *Sorghum halepense*<br>Johnson grass | ■ | ▲ | |
| *Tamarix* spp.<br>tamarisk | ■ | ▲ | |
| *Taraxacum* spp.<br>dandelion | ■ | ◊ | |
| *Trianthema portulacastrum*<br>horsepurslane | ■ | ◊ | |
| *Tribulus terrestris*<br>goathead, puncture vine | ■ | ▲ | ■ |
| *Triticum aestivum*<br>wheat | □ | ◊ | |
| *Vulpia myuros*<br>foxtail fescue | ■ | ◊ | |

| Exotic species | Present in the park | Proposed for treatment | State listed* |
|---|---|---|---|
| *Zea mays*<br>corn | □ | ◊ | |

* Arizona Department of Agriculture: Noxious and Restricted Weeds, 2004

### SCOPING

Scoping is an early and open process to determine the breadth of environmental issues and alternatives to be addressed in an environmental assessment. The staff of Saguaro National Park conducted internal scoping in March 2004. This interdisciplinary process defined the purpose and need, identified potential actions to address the need, determined what the likely issues and impact topics would be, and identified the relationship, if any, of the proposed action to other planning efforts at the park.

Public scoping for this project was formally initiated on April 9, 2004 with the release of a press release and public scoping letter (see appendix A for the text of both). The letter was sent to 63 agencies, tribal governments, and organizations. The letter solicited the public's concerns, viewpoints, and comments regarding the planning and implementation of the proposed project. The press release was not published in either of the two primary newspapers (*Arizona Daily Star* and the *Tucson Citizen*); therefore a notice was placed in the 'Legal' section of the two newspapers on April 26, 2004. A total of three comments were received during the public scoping period that were general comments supporting the park's planning efforts or inquired about information.

# RELATIONSHIP OF THE PROPOSED ACTION TO PREVIOUS PLANNING EFFORTS

Managing exotic plant species is consistent with Saguaro National Park's General Management Plan (NPS 1988), the Statement for Management (NPS 1995), and the Strategic Plan for Saguaro National Park (NPS 2000). It is also consistent with the National Park Service Management Policies (NPS 2001b) and Executive Order 13112 (1999). All of these planning documents discuss the need for and/or importance of monitoring and controlling non-native species to protect park resources. The State of Arizona also requires monitoring and eradication/control of exotic plants that are listed as noxious weeds (AZ R3-4-244 and R3-4-245); several of the listed noxious weed species occur, or have the potential to occur, in Saguaro NP.

# IMPACT TOPICS

Issues and concerns affecting the proposed action were identified by an interdisciplinary team consisting of park managers and resource specialists at Saguaro National Park. Impact topics are the resources of concern that could be affected by the range of alternatives. Specific impact topics were developed to ensure that alternatives were compared on the basis of the most relevant topics. The following impact topics were identified on the basis of federal laws, regulations, orders, and National Park Service Management Policies (2001b). A brief rationale for the selection of each impact topic is given below, as well as the rationale for dismissing specific topics from further consideration.

# IMPACT TOPICS SELECTED FOR ANALYSIS

### SOILS

According to the NPS Management Policies (2001b), the National Park Service will strive to understand and preserve the soil resource of park units and to prevent, to the greatest extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources. Proposed activities have potential to impact the soil resource; therefore, this topic will be analyzed further.

### VEGETATION

The National Park Service strives to preserve and restore native plant communities contained in national park units while minimizing human impacts on native plants, animals, communities, and ecosystems, and the processes that sustain them (NPS 2001b). Proposed activities have potential to impact the vegetation; therefore, this topic will be analyzed further.

### WILDLIFE

As discussed above with vegetation, the policy of the National Park Service is to protect the components and processes of naturally occurring wildlife communities, including the natural abundance, diversity, and ecological integrity of animals (NPS 2001b). The proposed alternatives have the potential to affect wildlife or their habitats; therefore, this topic will be analyzed further.

### SPECIAL-STATUS SPECIES (THREATENED, ENDANGERED, SPECIES OF CONCERN, AND DESIGNATED CRITICAL HABITAT)

The Endangered Species Act of 1973 (16 United States Code (USC) 1531 *et seq*.) requires an examination of the impacts of all federal actions on federally listed threatened or endangered species. National Park Service policy (2001b) also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species. The proposed actions may have adverse or beneficial impacts to some of these species or their habitats; therefore, this topic will be analyzed further.

### WATER QUALITY AND QUANTITY

The NPS seeks to restore, maintain, and enhance the quality of all park surface and ground waters consistent with the 1972 Federal Water Pollution Control Act, as amended, and other applicable federal, state, and local laws and regulations. The proposed actions may have adverse or beneficial impacts to the water quality or quantity; therefore, this topic will be analyzed further.

### ARCHEOLOGICAL RESOURCES AND HISTORIC STRUCTURES

Section 106 of the National Historic Preservation Act of 1966, as amended, and National Park Service policy require that the effects of National Park Service actions on properties eligible for or listed on the National Register of Historic Places be considered, and that appropriate steps be taken to avoid, minimize, or mitigate these effects. Previous research has shown that these types of resources do exist throughout the park; therefore they could have the potential to be affected by the proposed project. Archeological resources and historic structures will be discussed further in this document.

### WILDERNESS

Saguaro National Park contains 71,400 acres of designated wilderness. Saguaro NP wilderness management seeks to provide outstanding opportunities for solitude or a primitive and unconfined type of recreation, and the opportunity for connection with the out-of-doors. In addition to an absence of human-produced structures and roads, wilderness is also defined by its visual, auditory, and social characteristics. The Wilderness Minimum Requirement Analysis for this project is attached (Appendix B). The purpose of the analysis is to minimize impacts on wilderness character and resources. During the development of

alternatives, wilderness was a primary consideration. Proposed actions will occur throughout the park, including designated wilderness; therefore, this topic will be discussed further in this document.

### HUMAN HEALTH AND SAFETY

The NPS is concerned about employee and visitor health and safety. Proposed actions would have negligible to minor effects on the health or safety of park employees, and negligible to no effects on the health and safety of visitors. This topic will be discussed further in this document in several locations - Mitigation Measures (in Chapter 2), Environmental Consequences (Chapter 4), and Safety Plan (Appendix C).

# IMPACT TOPICS DISMISSED FROM FURTHER CONSIDERATION

Issues and concerns affecting the proposed action were identified by an interdisciplinary team at Saguaro National Park. After internal and public scoping, issues and concerns were distilled into distinct impact topics to facilitate the analysis of environmental consequences, which allows for a standardized comparison between alternatives based on the most relevant information. The impact topics were identified on the basis of federal laws, regulations, and orders; NPS Management Policies (2001b); and NPS knowledge of limited or easily impacted resources. The rationale for dismissing specific topics from further consideration is given below.

### AIR QUALITY

The 1963 Clean Air Act, as amended (42 USC 7401 *et seq*.), provides that the federal land manager has a responsibility to protect the park's air quality-related values (including visibility, plants, animals, soils, water quality, cultural and historic resources and objects, and public health) from adverse air pollution impacts. Section 118 of the 1963 Clean Air Act requires the park to meet all federal, state, and local air pollution standards. Section 176(c) of the 1963 Clean Air Act requires all federal activities and projects to conform to state air quality implementation plans to attain and maintain national ambient air quality standards. NPS Management Policies 2001 addresses the need to analyze potential impacts to air quality during park planning.

Saguaro National Park is classified as a Class I air quality area under the Clean Air Act, as amended. Should the preferred alternative be selected, there could be localized air pollution from the use of gasoline-powered string trimmers or chainsaws that would cause some dust and exhaust emissions. This would have a short-term, localized, negligible impact on air quality. The use of inorganic chemicals could pose a short-term localized negligible impact to air quality, principally from drift. Impacts to air quality will be reduced and mitigated by limiting spraying to days when the air is calm (please refer to the Mitigation Measures in Chapter 2 and the Safety Plan in Appendix C).

Overall, there would be a slight and temporary degradation of local air quality due to the use of gasoline-powered equipment (e.g. string-trimmers) or herbicides. These effects would last only as long as the particular treatment occurred and the park's Class I air quality would not be affected by the proposal; impacts would be negligible and short term. No long-term adverse impacts to air quality related values would occur from implementing this project. The reduced potential for wildfire at the lower elevations (through removal of exotic plant species that create high fuel loads) could result in a negligible beneficial impact to the air quality. Therefore, air quality was dismissed as an impact topic in this environmental assessment.

## FLOODPLAINS AND WETLANDS

Executive Order 11988 (*Floodplain Management*) requires an examination of impacts to floodplains and potential risk involved in placing facilities within floodplains. NPS Management Policies, Director's Order – 2: Planning Guidelines, and Director's Order-12: Conservation Planning, Environmental Impact Analysis, and Decision-making provide guidelines for proposed actions in floodplains. Upon consultation with an NPS Regional Hydrologist, it was determined that the proposed actions will not have any impacts to the floodplains or the functioning of the floodplains. The proposed actions would not change the ability of a floodplain to convey floodwaters or its values and functions, nor would the proposed actions contribute to a flood; therefore this topic will not be analyzed further.

Executive Order 11990 (*Protection of Wetlands*) requires and examination of impacts to wetlands. An official wetlands delineation has not been completed according to US Army Corps of Engineers protocols, but it has been completed by US Fish and Wildlife Service National Wetlands Inventory (NWI) using a more conservative definition of wetlands. Based upon the NWI maps, the park does contain wetlands. Upon consultation with US Army Corps of Engineers and an NPS Regional Wetlands Program Manager, it has been determined that because mitigation measures that will be strictly adhered to, there will be no impact to wetlands; therefore this impact topic will not be analyzed further.

## SOUNDSCAPE

The NPS is mandated by Director's Order 47 to articulate National Park Service operational policies that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources. Natural sounds are intrinsic elements of the environment that are often associated with parks and park purposes. They are inherent components of "the scenery and the natural and historic objects and the wildlife" protected by the NPS Organic Act. Natural sounds are vital to the natural functioning of many parks and may provide indicators of the health of various ecosystems. Intrusive sounds are of concern to the NPS because they sometimes impede the Service's ability to accomplish its mission. String trimmers may be used in certain circumstances, but the effect would be short-term and localized. Much of the project will occur in the wilderness; therefore noise from power equipment is discussed in detail under that impact topic. This project would have temporary, negligible effects on the soundscape. Therefore, soundscape was not analyzed as an impact topic.

## PRIME AND UNIQUE FARMLANDS

In August 1980, the Council on Environmental Quality (CEQ) directed that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as prime or unique. Prime or unique farmland is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. According to NRCS (USDA 2002), none of the soils in the project area are classified as prime and unique farmlands. Therefore, the topic of prime and unique farmlands was dismissed as an impact topic in this document.

## VISITOR USE AND EXPERIENCE, RECREATION RESOURCES

The proposed action would neither change visitor use and experience nor appreciably impact the recreation resources of Saguaro National Park. Control efforts in high public use areas would be primarily completed by hand-pulling, so impacts to visitor use and experience will be negligible to none. The

control of exotic plants will not impact the recreation resources of the park. Therefore, visitor use and experience and recreation resources were not addressed as impact topics in this document.

### PARK OPERATIONS

The proposed action would not significantly change overall park operations. The proposed action would enable the park to more effectively manage exotic plant populations. However, the Restoration Program would need to maintain 3.5 FTEs (full-time equivalents) in order to effectively manage exotic plant populations and restore native populations in the long term. Because the proposed action would not significantly change overall park operations, this topic was not addressed in this document.

### SOCIOECONOMIC ENVIRONMENT

The proposed action would neither change local and regional land use nor appreciably impact local businesses or other agencies. Therefore, socioeconomic environment was not addressed as an impact topic in this document.

### NATURAL LIGHTSCAPES

In accordance with National Park Service Management Policies (2001b), the National Park Service strives to preserve natural ambient lightscapes, which are natural resources and values that exist in the absence of human-caused light. Exotic plant control activities will have no impact on natural lightscapes because all work will occur during daylight hours. Therefore, natural lightscape was dismissed as an impact topic in this document.

### ETHNOGRAPHIC RESOURCES

Ethnographic resources are defined by the National Park Service as a "site, substance, object landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it (Director's Order – 28)." American Indian tribes traditionally associated with Saguaro National Park, including the Ak Chin Indian Community Council, Fort McDowell Yavapai Nation, Gila River Indian Community Council, Hopi Tribe, Pascua Yaqui Tribe, Salt River Pima-Maricopa Indian Community, Tohono O'odham Nation, and Zuni Tribe, were apprised of the proposed action by letter on April 9, 2004. No responses have been received. The National Park Service will continue to consult with these American Indian groups and copies of the environmental assessment will be forwarded to each affiliated tribe or group for review or comment. If subsequent issues or concerns are identified, appropriate consultations would be undertaken. Because it is unlikely that ethnographic resources will be affected, and because appropriate steps will be taken to protect any human remains, funerary objects, sacred objects, or objects of cultural patrimony inadvertently discovered, ethnographic resources was dismissed from detailed analysis.

### CULTURAL LANDSCAPES

According to the National Park Service's Cultural Resource Management Guidelines (DO-28), a cultural landscape is "…a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by the physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions."

Thus, cultural landscapes are the result of the long interaction between man and the land, and the influence of human beliefs and actions over time upon the natural landscape. Shaped through time by historical land-use and management practices, as well as politics and property laws, levels of technology, and economic conditions, cultural landscapes provide a living record of an area's past, a visual chronicle of its history. The dynamic nature of modern human life, however, contributes to the continual reshaping of cultural landscapes; making them a good source of information about specific times and places, but at the same time rendering their long-term preservation a challenge.

The initial stage of Cultural Landscape identification, called Level 0 in the NPS Cultural Landscape Inventory process, has identified several potential cultural landscapes at Saguaro National Park. Identification of a landscape at Level 0 indicates the need for both research and evaluation. Potential landscapes identified include the prehistoric, historic and ethnographic periods, making this quite complex. Implementation of any of the alternatives presented in this document would not alter the topography, native vegetation, circulation features, spatial organization, or land use patterns of the landscape. Because the integrity of the existing landscape would be unaffected, cultural landscapes was dismissed as an impact topic.

### ENVIRONMENTAL JUSTICE

Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. The proposed action would not have disproportionate health or environmental effects on minorities or low-income populations or communities as defined in the Environmental Protection Agency's Environmental Justice Guidance of 1998. Therefore, environmental justice was dismissed as an impact topic in this document.

# CHAPTER 2 - ALTERNATIVES CONSIDERED

## INTRODUCTION

Saguaro National Park developed the following alternatives from key issues and objectives noted in Chapter I. The no action alternative evaluates the existing situation and trend and serves as a baseline for comparing the action alternative. This chapter describes one management alternative, in addition to the no action alternative. Under CEQ guidance, reasonable alternatives are those "that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant…" In developing alternatives, some actions were considered and dismissed; these are summarized at chapter's end.

## NO ACTION ALTERNATIVE

Under this alternative, the park would continue to control most species using mechanical treatment (hand tools only). The use of herbicides would be limited to a few individual non-native tree species. Should the no action alternative be selected, the NPS would respond to future needs and conditions associated with exotic plant management without major actions or changes in course. Under the no action alternative, the park would be limited to controlling only individual plants or very small patches of exotic plant species. Saguaro National Park would not be in compliance with federal and state laws and policies regarding noxious plant removal and preservation of the park's resources would be compromised by uncontrolled invasive plant species.

## PREFERRED ALTERNATIVE

The preferred alternative is the agency's (NPS) preferred alternative and defines the rationale for the action in terms of resource protection and management, visitor and operational use, costs, and other applicable factors. All actions described in the preferred alternative are consistent with the approved 1988 Saguaro National Park General Management Plan, related park documents, NPS guidelines and policies, and all other laws and regulations.

Under this alternative, the park would use an integrated, proactive approach to control non-native species by selecting the most effective treatment for that species and location (i.e. adaptive management). This approach would use cultural, mechanical, chemical, low risk, and biological treatments individually or in combination. Cultural control includes revegetation with native plant species and education of visitors and staff regarding exotic plants. Mechanical control involves using hand tools or mechanized tools (string trimmers or chainsaws) to control exotic plants. Chemical control would involve the use of the herbicides proposed for use in this document. Low risk treatments include using hot water/steam, vinegar compounds, or plastic sheeting to control exotic plants. Biological treatments would involve the use of grazing animals or insects to control exotic plants. Chapter 3 describes in detail the proposed plan and action for exotic plant management within Saguaro NP.

The park is not proposing to remove native plant populations. The park also will not focus control efforts on plants whose origins are uncertain, unless those species are definitively determined in the future to be exotic plants (for example, *Xanthium strumarium* (cocklebur), *Conyza bonariensi* (horseweed), or others).

Adaptive management is part of the preferred alternative. Exotic plant infestations are dynamic; even the most complete inventory will quickly be out of date. New infestations and new species are the highest priority for treatment. New methods or materials may become available that are better suited to a situation

than those currently recognized. Adaptive management allows flexibility in changing treatment methods, such as adjusting the timing or frequency of treatments.

Adaptive management includes the following:

- Treatments of infestations of exotic plants that may become established but which are not currently identified on the species list or known to occur in the park;
- The use of approved herbicide, adjuvant, and surfactant formulations that may not be specifically listed by trade name in the proposed action (adjuvants and/or surfactants may be added to the herbicides to improve efficacy), and;
- If prescribed management fails to result in desired outcome, alternative strategies will be developed, and management will be adapted until the desired conditions are achieved. New alternative strategies will be reviewed on a site-specific and case-by-case basis. If it is demonstrated through analysis that the environmental impacts of a new approach fall outside the impacts as disclosed in this document, then additional environmental and cultural analysis would be undertaken under NEPA and §106.

## ITEMS APPLICABLE TO THE PREFERRED ALTERNATIVE

### Herbicide Use Approval

The NPS maintains strict control over pesticide use on national park lands. NPS Management Policies state that "proposed pest management activities must be conducted according to the IPM process prescribed in Director's Order #77-7: Integrated Pest Management." Integrated Pest Management (IPM) is defined as "a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment." The pesticide use approval process requires that each park request permission to use pesticides; these requests must be renewed annually. The Intermountain Support Office IPM coordinator approves or denies pesticide use per project based on established NPS guidelines. The park currently has approval for the use of Garlon (triclopyr) for tamarisk control and Roundup Pro (glyphosate) for experimental plots testing the effectiveness of buffelgrass control methods. Approvals would be obtained for any other herbicides described in this plan prior to their use in the park. Approval would also be obtained prior to using either of the previously approved chemicals in a setting different than originally approved. The park is required to keep accurate records about the amount of chemical used and the total acreage to which it is applied. Computerized records are submitted to the regional office on an annual basis.

### Herbicide Mixture

Herbicides would be mixed strictly according to labeled mixtures and uses. There are currently no invasive aquatic plant species, therefore it is not anticipated that any herbicide mixtures would be applied directly to standing water. Any exotic plants that occur in ephemeral drainages would be treated with herbicides labeled for aquatic use.

### Project Participants

NPS staff would lead all eradication efforts involving chemical, biological, or low-risk control. Only NPS staff or volunteers with a State of Arizona pesticide applicator's certification (through the State Structural Pest Control Commission) would apply herbicides. The applicators would need to be certified for pesticide applications in right-of-ways and weeds. Trained volunteers may lead mechanical control efforts at the direction of park staff. In keeping with wilderness management practices, participants would be kept to the minimum necessary to accomplish project objectives.

### Plan Implementation and Monitoring

Control efforts would begin in 2005 and continue for eight years. During this time, eradication and control efforts will be recorded and monitored to determine the most effective method of control. Control strategies will be revised as determined by monitoring and results of applicable research studies. See Chapter 3 for more detailed information.

### Follow-up Treatments

Follow-up treatments may be necessary to ensure that control objectives are met. Follow-up treatments may involve either mechanical or chemical control that is necessary to control or eradicate exotic plant species. Follow-up treatments are tied directly to monitoring because all locations that are treated will be revisited at least yearly to determine treatment success.

## MITIGATION MEASURES APPLICABLE TO PREFERRED ALTERNATIVE

### Cultural Resources

Park staff conducting exotic plant management work would be trained yearly in cultural site awareness to learn how to identify and avoid archeological and historical resources on the ground. This training has been very successful in the past in assuring protection of park cultural resources (Wells 2004). Should presently unidentified archeological resources be discovered during project implementation, work in that location would stop until the resources are properly recorded by an NPS archeologist and evaluated under National Register of Historic Places eligibility criteria in consultation with the Arizona State Historic Preservation Officer (SHPO) and tribes as appropriate. If the resources are determined eligible, appropriate measures would be implemented either to avoid resource impacts or to mitigate disturbance. In compliance with the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), the NPS would also notify and consult affiliated tribal representatives for proper treatment of human remains, funerary, and sacred objects, should these be discovered. All workers would be informed of penalties for illegally collecting artifacts or intentionally damaging any archeological or historic property in the vicinity. Should any unusual treatment conditions or locations arise related to cultural resources, the park would contact the consulting archeologist to determine how to proceed.

If exotic plant infestations occur in areas with archeological sites, the preferred control method may be chemical control to avoid disturbance of the artifacts.

### Exotic Vegetation and Noxious Weeds

Newly discovered invasive plant species and infestations would be mapped with a GPS unit, and the park's Restoration Ecologist would be notified. All workers' clothing and footwear and all tools and equipment will be cleaned at the treatment sites to ensure that seeds or propagules from invasive exotic plants are not transported to new locations.

### Herbicide Application and Employee Safety

All herbicides proposed for use are general-use herbicides, and pesticide certification is not required for application. However, the park has adopted the policy of having trained and certified applicators on site during projects involving herbicides. Only certified applicators would apply herbicides. Arizona State pesticide application certification, including herbicide training and safety, is renewed annually. All project participants would receive herbicide training from the project leader. Project participants would understand and abide by the established Personal Protective Equipment (PPE) requirements and rules

outlined in the safety plan. Rubber gloves, long sleeve shirts, and goggles are part of the PPE necessary for this project. Job hazard analyses (JHA) for exotic plant removal and herbicide application have already been prepared and would be reviewed frequently with all project participants.

All information and instructions on the herbicide label would be strictly followed. All herbicide containers would show the product label and would be leak- and spill- resistant. All application equipment and chemicals would be stored in appropriate storage facilities. Material Safety Data Sheets (MSDS) would be maintained for all chemicals. The MSDS contains fire and explosive hazard data, environmental and disposal information, health hazard data, handling precautions, and first aid information. All participants would review the MSDS with the project leader and understand first aid instructions described on the MSDS. Appendix C includes a safety plan with specific guidance for hazardous materials. All herbicide and application equipment would be stored separately from food and personal items.

Large exotic plant infestations that occur in ephemeral drainages will be primarily be controlled using herbicides so that the soil remains relatively undisturbed. This will reduce or eliminate disturbances to floodplains and wetlands. Herbicides used in ephemeral drainages will be labeled for aquatic use.

Herbicides with the potential to volatize (triclopyr or ester forms of 2, 4-D) will not be used when conditions would favor volatizing and subsequent harm to non-target plants.

Herbicides will not be used when temperature, humidity, or wind conditions specified on the label are exceeded.

Herbicides will not be used in high visitation areas unless the exotic plant infestation is greater than 100 plants. If a high visitation area needs to be treated, the area will be closed during treatment (including a buffer around the treatment area) until re-entry is allowed (as defined on the product label) and will be signed before and after treatment. Treatments would occur when the least number of visitors would be impacted by the closure.

**Native Plant Restoration**

Active native species restoration may be used in project areas when funding and propagules are available. All restoration efforts would use site-adapted native seed and/or plants. Restoration would seek to restore the natural conditions prior to exotic species arrival and to prevent re-invasion. Active restoration would include the collection of seed and/or cuttings from native plants in the project area. Any seed spreading or planting of cuttings would seek to replicate the composition and structure of the native plant communities. Extensive monitoring and maintenance would be conducted in these areas to ensure project success.

**Soil Compaction and Biotic Community Disturbance**

To minimize soil compaction, the following mitigation measures would be incorporated into all action alternatives:

• The minimum number of workers necessary to complete the work would be used.

• The project leader would determine the access route that would cause minimal disturbance to sensitive soils and vegetation. Access to areas would use existing wildlife or hiking trails wherever possible. If no trails exist, the project leader would determine whether single or multiple paths would be used depending on which would cause the least impact.

• The minimum number of trips to sensitive areas would be conducted for follow-up treatments and/or monitoring.

**Special Status Species**

The following mitigation measures would be incorporated into all action alternatives:

- The proposed project would include provisions for the discovery of previously unknown or undiscovered threatened, endangered, or special status species. These provisions require the cessation of project activities until park staff evaluates the project impact on the discovered species and conducts additional Section 7 consultation with the U.S. Fish and Wildlife Service if necessary.

- All project participants would be informed about special status species and what actions should occur if a special status species is encountered.

- Work involving string trimmers or chainsaws will not occur during breeding and dispersal periods for threatened, endangered, or special status species (in a particular species' habitat).

- *Bats (including lesser long-nosed)*: String trimmers would not be used within 100 feet of an entrance to a known bat roost. To minimize disturbance to roosting bats, work would be completed in seasons when the bats are not present, or exotic plant species would be removed using methods least likely to disturb the bats (hand tools or chemical control). Workers would keep group size and noise to a minimum to avoid disturbing bats.

- *Cactus ferruginous pygmy-owls:* String trimmers would not be used around dawn or dusk when in pygmy-owl habitat during the breeding season (February 1 – July 31). If a pygmy-owl is discovered in the park, no exotic plant control work would be allowed during the breeding season within one-half mile of a known nest site. In addition, if a pygmy-owl is discovered we would consult with USFWS to determine the best method and timing of control to minimize disturbance to the owls. Pygmy-owl surveys would continue to be completed for the park every year.

- *Mexican spotted owl:* Current exotic plant data suggests that there will be no eradication or control work to be completed in Mexican spotted owl habitat. If exotic plants were to be found, then the following guidelines would be followed. Work in Protected Activity Centers (PAC) would be limited to 1-3 people with minimized activity and noise levels. Work would be conducted from September 1 –February 28 whenever possible to avoid the breeding season. There would be absolutely no work near known nests or roosts from March 1 to August 31. Mechanized equipment would not be used in PACs without consultation with the USFWS. Annual owl surveys are planned as part of the Fire Management Program, so the status and locations of owls would typically be known. This data would also be used to ensure the owls are not disturbed during potential exotic plant control work.

- *Yellow-billed cuckoo*: This is a migratory species; therefore work in lower elevation riparian gallery forests will be conducted in the winter to avoid disturbing yellow-billed cuckoos when possible. Workers would be trained to identify special-status species by sight and call. If a nest is found or suspected due to the behavior of the birds, then work would cease in the area until after the breeding and dispersal season.

**Wildlife**

The following general wildlife mitigation measures would be incorporated into all action alternatives:

- *Desert tortoises*: In areas where string trimmers will be used, work crews will survey the area to be treated for wildlife (e.g. lizards, snakes, rodents, and in particular, desert tortoise) immediately prior to the use of the equipment. If a desert tortoise is found, one person will monitor the tortoise and its movements during the work period to ensure its safety. The same protocols would apply to other wildlife species discovered that did not leave the area prior to beginning treatments.

- *Bats*: String trimmers would not be used within 100 feet of an entrance to a known bat roost. To minimize disturbance to roosting bats, work would be completed in seasons when the bats are not there, or exotic plant species would be removed using methods least likely to disturb the bats (hand tools or chemical control). Workers would keep group size and noise to a minimum to avoid disturbing bats.

- *Lowland leopard frogs*: Exotic plant control work is not anticipated to impact this species because currently there are no exotic aquatic plants found in the park. If aquatic exotic plant species were found, then we would consult with the park wildlife biologist or AZ Game and Fish Department biologists to determine the best method of control to minimize impact on the lowland leopard frogs.

- *Sensitive bird species*: High elevation sensitive bird species include the goshawk and the peregrine falcon. Work is not expected in the areas occupied by these species, but if exotic species were discovered then workers would avoid known or suspected nest sites during the breeding season. Workers would be trained to identify sensitive bird species by sight and call. If a nest is found or suspected due to the behavior of the birds, then work would cease in the area until after the breeding and dispersal season.

  Low-elevation sensitive bird species include the gray hawk, zone-tailed hawk, and the black hawk. Work will be completed in the winter to avoid the breeding season when possible. If work occurs during the breeding season, workers would be trained to identify sensitive bird species by sight and call. If a nest is found or suspected due to the behavior of the birds, then work would cease in the area until after the breeding and dispersal season.

**Tool Safety**

All project participants would receive tool safety training and would be required to use the appropriate PPE for each assigned task. The tools would be kept in appropriate storage locations at all times.

**Transportation**

From a practical standpoint, the majority of project locations are accessible only by hiking. The use of mechanized vehicles (outside of existing roadways) is not necessary to accomplish project objectives. Environmental Safety Standards and Job Hazard Analyses have been written and will be reviewed during weekly safety meetings.

**Visitor Experience**

NPS staff would provide educational and informational messages to any groups encountered during project implementation. Infestations located near heavily used areas will be mechanically controlled (if feasible) and the work will be completed when the visitors will be impacted least.

# ALTERNATIVES CONSIDERED, BUT DISMISSED

One alternative that was considered was the park having no invasive exotic plant management or control. This alternative was excluded from further consideration because it does not meet the requirements of the park's enabling legislation to protect natural resources, the NPS Organic Act, NPS policies, the federal and state Noxious Weed Acts, or Executive Order 13112 (*Invasive Species*).

Another alternative that was dismissed from further consideration was to control exotic plants only by mechanical and cultural methods. Certain exotic species require the use of chemical or biological methods for effective control (for example, some deep-rooted and/or root-propagated perennial weeds require treatment with herbicides to be effective). Allowing those species to remain untreated in the park would not meet the requirements of the park's enabling legislation to protect natural resources, the NPS Organic Act, NPS policies, the federal and state Noxious Weed Acts, or Executive Order 13112 (*Invasive Species*), therefore this alternative was excluded from further consideration.

**Table 3. Comparative summary of each alternative's features, and the potential to accomplish proposed plan objectives.**

| | **NO ACTION ALTERNATIVE**<br>**Continue limited exotic plant management by mechanical methods** | **PREFERRED ALTERNATIVE**<br>**Use an integrated approach for exotic plant management (mechanical, chemical, cultural, biological & low-risk methods)** |
|---|---|---|
| **Features** | The park would continue to control most exotic species using mechanical treatment. Herbicides would be used on an extremely limited basis. Under the no action alternative, the park would be limited to controlling only individual plants or very small patches of exotic plant species. Saguaro National Park would thus not be in concert with Federal and state laws and policies regarding noxious plant removal and preservation of the park's resources. | The park would use an integrated, proactive approach to control non-native species by selecting the most effective treatment for that species and location (i.e. adaptive management). This approach would combine using cultural, mechanical, chemical, low-risk, and biological treatments.<br>An integrated approach will allow the park to minimize impacts while working in concert with policies and laws to control invasive exotic plants and preserve the park's resources. |
| **Objective 1. Prevent any new exotic species from becoming established.** | Mechanical control can be an effective method for eradicating small infestations or single individuals of new species. If new species spread rapidly or vegetatively (e.g. from roots or rhizomes), mechanical control may be insufficient to prevent establishment. | Mechanical control can be an effective method for eradicating small infestations or single individuals of new species. Chemical methods (herbicides) used alone or in combination with mechanical methods will allow managers to eliminate new plants that spread rapidly or vegetatively. Revegetation efforts (cultural control) will reduce the park's susceptibility to invasions by new species. Education and outreach (cultural control) will reduce introductions of new plants by park visitors. |
| **Objective 2. Immediately treat any new infestations of the 13 species previously found in and currently eradicated from the park** | Mechanical control is generally effective for eliminating new or isolated populations of exotic species. If species spread rapidly or vegetatively (e.g. from roots or rhizomes), mechanical control may be insufficient to prevent establishment. | Mechanical control is generally effective for eliminating new or isolated populations of exotic species. Use of herbicides will enhance the efficacy of mechanical control and allow for control and containment over a larger area or for species that reproduce vegetatively. Revegetation efforts will help stem the spread of invasive species by increasing native plant communities' competitiveness and decreasing available habitat for exotic species. |
| **Objective 3. Eradicate 17 species which are** | Mechanical control is costly and labor intensive, and is ineffective in treating those species that reproduce vegetatively. The high cost and labor | Chemical control will be used both in concert with mechanical methods and on its own, allowing for eradication of large, established infestations of exotic |

| | | |
|---|---|---|
| **the most invasive and pose the greatest threat to the biological diversity within the park** | intensiveness of mechanical methods may preclude control or containment of species that have large infestations or are spreading rapidly. | plants that displace native organisms and change ecological cycles. Revegetation will help prevent re-infestation of those areas that are disturbed or laid barren by control of exotic plants. Biological control methods may provide an avenue for control of those species that are persistent and detrimental to native plants and wildlife over large areas. |
| **Objective 4. Eradicate, contain, or control the spread of 63 known invasive species in future years as time, funding, and scientific knowledge allow** | Mechanical control is costly and labor intensive, and is ineffective in treating those species that reproduce vegetatively. Therefore, mechanical control alone is generally insufficient to eradicate invasive species that have become well-established or those that reproduce vegetatively. | Mechanical control is generally effective for eliminating new or isolated populations of exotic species. Chemical control will be used both in concert with mechanical methods and on its own, allowing for eradication of large, established infestations of exotic plants that displace native organisms and change ecological cycles. Revegetation will help prevent re-infestation of those areas that are disturbed while controlling exotic plants. Biological control methods may provide an avenue for control of those species that are persistent and detrimental to native plants and wildlife over large areas. |

## Table 4. Comparative summary of impacts for the proposed alternatives.

| **Impact Topic** | **NO ACTION ALTERNATIVE**<br>**Continue limited exotic plant management by mechanical methods** | **PREFERRED ALTERNATIVE**<br>**Use an integrated approach for exotic plant management (mechanical, chemical, cultural, biological & low-risk methods)** |
|---|---|---|
| **Soils** | Attempts to control large infestations of exotic plants by mechanical means could reduce soil stability. Ineffective management of infestations (due to high time/cost requirements of mechanical removal) could result in spread of exotic plants, causing changes in soil stability and nutrient availability. Adverse impacts to soils would be short and long term, minor and localized. | Impacts to soil stability would be minimized by using alternative (non-mechanical) means of control for large infestations. Adverse impacts from mechanical control of small infestations would be short term, minor, and localized.<br><br>Use of chemical herbicides could potentially have adverse, short-term, minor, localized impacts to soil microorganisms. Cultural control efforts (active revegetation) and passive revegetation resulting from removal of exotics would have beneficial effects on soil nutrient availability and cycling, water availability, and soil erosion. Certain biological control methods (i.e. use of animals to graze infested areas) could cause soil compaction, with minor, short-term adverse impacts on soils. Low-risk methods (especially plastic sheeting) may have negligible, short-term, localized adverse impacts to soil microorganisms.<br><br>Overall adverse impacts of the preferred alternative to soils would be negligible to minor and short-term; beneficial impacts would be minor and long-term. |
| **Vegetation** | Where it is completed, mechanical treatment will restore native vegetation, creating a beneficial, localized, long-term, minor impact. Mechanical methods may have negligible, localized, adverse impacts when exotic plants are pulled that are growing adjacent to natives.<br><br>Infestations that are not treated due to time/cost constraints of mechanical treatment will continue to have adverse, moderate, long-term | Mechanical methods will have a negligible, localized, adverse impacts when exotic plants are pulled that are adjacent to natives. Herbicides can injure or kill non-target plants, with short-term, negligible, localized, adverse impacts, but chemical control of exotic plants would have long-term, moderate beneficial impacts on native vegetation. Cultural control would have a minor, long-term, beneficial impact on native vegetation by restoring previously infested areas with native vegetation. Biological control methods such as |

| Impact Topic | NO ACTION ALTERNATIVE<br>**Continue limited exotic plant management by mechanical methods** | PREFERRED ALTERNATIVE<br>**Use an integrated approach for exotic plant management (mechanical, chemical, cultural, biological & low-risk methods)** |
|---|---|---|
| | impacts to native vegetation through competition and change of fire cycle (i.e. introduction of fire to Sonoran desertscrub). | using herbivores to control exotics could have minor, short-term, adverse impacts to native vegetation. Low-risk methods could have short-term, localized, negligible impacts.<br><br>To the degree that they effectively remove exotic plant species, all of these methods will have moderate, long-term, beneficial impacts to native plant communities by reducing competition and preventing wildfire in plant communities not adapted to fire. |
| **Wildlife** | Mechanical control methods may have a short-term, negligible adverse effect on vertebrate or invertebrate species inhabiting exotic species that are removed. Short-term displacement of wildlife may occur during treatments, but the impact is expected to be negligible.<br>Overall, long-term, moderate, adverse impacts to wildlife will continue to occur as exotic species modify native habitat characteristics like cover, forage, and fire cycle. | All control methods may have a short-term adverse effect on vertebrate or invertebrate species inhabiting exotic species that are removed. Temporary displacement of wildlife may occur during treatments, but the impact is expected to be negligible and localized. Chemical control methods are not expected to affect wildlife under normal application conditions, but could have short-term, negligible, adverse impacts on wildlife species. Cultural control/revegetation would have a minor, long-term, beneficial impact on native wildlife species by restoring native vegetation. Biological control methods could have minor, short-term, adverse impacts to wildlife through competition for food. Low-risk methods are not expected to have an effect on wildlife. Overall, these methods could have short-term, negligible to minor, adverse impacts on wildlife.<br><br>To the degree that they effectively remove exotic plant species, all of these methods will have moderate, long-term, beneficial impacts to native wildlife by restoring native habitat and by preventing wildfire in non-fire-adapted plant communities. |
| **Endangered, Threatened and Rare Species** | Mechanical control methods could temporarily displace or disturb special-status wildlife species, causing a localized, short-term, negligible, adverse impact.<br>Failure to remove and prevent exotic plant infestations will have long-term, moderate, adverse impacts to special-status species through competition and change of fire cycle (e.g. introduction of fire to Sonoran desertscrub). | Mechanical control methods could temporarily displace or disturb special-status wildlife species, causing a localized, temporary, negligible adverse impact. The herbicides proposed for use under chemical control methods act upon plant-specific enzyme pathways; therefore the impact to special-status wildlife species under normal application conditions would be negligible. If special-status plants were located in areas where herbicides were to be used, a buffer would be left around the special-status species and exotic plants within the buffer zone would be hand-pulled rather than treated with herbicides.<br>Cultural control would have a minor, long-term, beneficial impact on special-status species by restoring previously infested areas with native vegetation. Using biological control could have minor, short-term, adverse impacts on special-status wildlife (e.g. through competition for food) if the method is not selected and monitored very carefully. Low-risk methods could impact special-status plant species if they are growing adjacent to the exotic plants.<br>All of the methods described under the preferred alternative will have moderate, long-term, beneficial impacts to special-status species and their habitats |

| Impact Topic | NO ACTION ALTERNATIVE<br>Continue limited exotic plant management by mechanical methods | PREFERRED ALTERNATIVE<br>Use an integrated approach for exotic plant management (mechanical, chemical, cultural, biological & low-risk methods) |
|---|---|---|
| | | when applied and monitored as prescribed in this plan. Native plant communities will be restored by removing exotic plant species. Removal of exotic plant species will also reduce the risk of wildfires at the lower elevations where native plant and animal species are not adapted to fire. Overall, the preferred alternative will have short-term, negligible, adverse, localized impacts to special-status species, and long-term, moderate, beneficial impacts to special-status species. |
| **Water Quantity and Quality** | Exotic plant species would primarily be controlled by mechanical (hand tool) methods which could result in reduced water quality in drainages after significant rain events. The exotic plant infestations would not be effectively managed under this alternative because of the large amount of time it takes to mechanically remove populations; therefore locations that did not receive treatment could see changes in water availability/quantity when compared to areas containing native vegetation. Mechanical control would result in minor, localized, short-and long-term, adverse impacts to water quality and quantity. | Mechanical control is expected to have short-term, negligible, localized, and adverse impacts on water quality or quantity. With the implementation of mitigation measures, the use of chemical control could have negligible, short-term, localized, adverse impacts on water quality and quantity. Cultural control would have a minor, long-term, beneficial impact on water quality and quantity by returning native vegetation to currently infested areas. Biological control, such as bringing in animals to graze exotic plants, could have minor, short-term, adverse impacts on water quality or quantity if they used locally available water supplies. Low-risk methods will not likely impact water quality or quantity, but could have negligible, short-term, localized, adverse impacts to water quality and quantity.<br>Removing exotic plant species will lead to restoration of native plant communities. This will have positive effects on soil nutrient availability and cycling, water availability, and soil erosion. Consequently, the preferred alternative will have negligible, short-term, adverse impacts and minor, long-term, beneficial impacts on the water quality and quantity. |
| **Archeological Resources and Historic Structures** | Mechanical control methods could have minor adverse impacts to archeological resources if they are unknown and uncovered during exotic plant removal. Some exotic plant infestations could not be treated with mechanical control methods due to the type of archeological resources present, and would be at a greater risk for fire. Those areas not treated could suffer adverse, moderate, long-term indirect impacts from fire.<br><br>Overall, the no action alternative would have minor to moderate, adverse impacts on archeological resources and historic structures. | Mechanical control methods could have minor adverse impacts to archeological resources if they are unknown and uncovered during exotic plant removal. Herbicides could be used to control exotic plants in sensitive archeological areas where use of hand tools is restricted or prohibited. This could have negligible direct impacts to these cultural resources if the herbicide is sprayed directly on the archeological resources. Cultural control would have a negligible adverse impact on archeological resources through the ground-disturbing activities associated with native plant revegetation. Biological and low-risk methods are not expected to have any impact on cultural resources.<br><br>Overall, the preferred alternative will have long-term, minor, beneficial impacts on archeological resources and historic structures. |
| **Wilderness** | The use of hand tools to remove non-native plant populations would be within wilderness guidelines and would have no impact on the wilderness users. Not all exotic plant infestations would be controlled under the no action alternative, therefore the impact to the wilderness setting in the long term will be | The use of hand tools to remove non-native plant populations would be within wilderness guidelines and would have no impact on the wilderness users. String trimmers will have a short-term adverse impact on the wilderness user, but it will be localized and of a short duration. The use of chemical control as part of an integrated management program will have a long-term, |

| Impact Topic | NO ACTION ALTERNATIVE<br>Continue limited exotic plant management by mechanical methods | PREFERRED ALTERNATIVE<br>Use an integrated approach for exotic plant management (mechanical, chemical, cultural, biological & low-risk methods) |
|---|---|---|
| | adverse and moderate due to the degradation caused by the exotic plant species (i.e. through loss of native vegetation and associated impacts to native wildlife, fires in the lower elevations where fire does not normally occur). Overall, the no action alternative would have a short-term, localized, minor, adverse impact on the wilderness user, but a long-term, moderate, adverse impact to the wilderness setting, particularly at the lower elevations where the majority of the exotic species are found. | moderate, beneficial impact to the wilderness user and setting. Cultural control would have a long-term, minor, beneficial impact to the wilderness setting and user through restoration of native species. The biological and low-risk methods would have a long-term, minor, beneficial impact on the wilderness setting.<br><br>In addition, by removing exotic plant species through an integrated management program, native plant communities will be restored. This will reduce the risk of wildfire in the areas of the park that are not adapted to fire and will improve habitat for native wildlife species. The preferred alternative will have short-term, negligible to minor, adverse impacts on the wilderness user, but long-term, moderate, beneficial impacts on the wilderness user and setting. |
| **Human Health and Safety** | Mechanical methods of control could have direct, short-term, negligible, adverse impacts to the individuals performing the work. The fuel loads created by buffelgrass have the potential to cause very hot, fast fires which could have an indirect, long-term, minor to moderate (depending on the size and intensity of fire), adverse impact on human health and safety. Overall, the no action alternative would have a direct, short-term, negligible, adverse impact and an indirect, long-term, minor to moderate, adverse impact on human health and safety. | Mechanical methods of control could have direct, short-term, negligible, adverse impacts to the individuals performing the work. Due to mitigations and strict adherence to safety plans, chemical control could have a short-term, negligible, adverse impact on employee health and safety. The overall impact of chemical control on the health and safety of visitors will be short term, adverse, and negligible. Cultural control would have a short-term, negligible, adverse impact on employee health and safety due to potential injuries associated with native plant revegetation. Biological control would have no impact on human health or safety. Low risk methods would have a short-term, negligible, adverse impact on human health and safety.<br><br>Overall, the preferred alternative will have short-term, negligible, adverse impacts on human health and safety. |

# ENVIRONMENTALLY PREFERRED ALTERNATIVE

The Council on Environmental Quality defines the environmentally preferred alternative as "…the alternative that will promote the national environmental policy as expressed in the National Environmental Policy Act's §101." Section 101 of the National Environmental Policy Act states that "… it is the continuing responsibility of the Federal Government to …

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

Criteria 5 and 6 are not applicable to this Exotic Plant Management Plan.

The no-action alternative is not the environmentally preferred alternative because it would not fully meet criteria 1, 2, 3, or 4.

The National Park Service preferred alternative is the environmentally preferred alternative because it would:

- preserve the biodiversity and natural resources for which Saguaro National Park was created (criteria 1, 3, and 4), and

- protect the natural, cultural, and historic resources by providing a range of control options so that the control method with the least impact can be selected (criteria 2 and 4).

# CHAPTER 3 - PROPOSED ACTION AND PLAN

## IMPACTS OF INVASIVE EXOTIC PLANTS

Exotic plants infest approximately 2.6 million acres in the national park system, reducing the natural diversity these places were set aside to protect (NPS 2002). Invasive exotic plants are aggressive and competitive. They displace natural vegetation by robbing moisture, nutrients and sunlight from surrounding plants. Exotic plants can also increase the size and frequency of fire, a concern in ecosystems not adapted to fire (Esque et al. 2004). In 1994, Saguaro National Park had a large wildfire in the Sonoran desertscrub, an ecosystem not adapted to fire. The rapid spread and large size of this fire was attributed to invasive exotic plants (Esque and Schwalbe 2002, Esque et al. 2004). Of the many species that were affected by the fire, two long-lived species in particular experienced high mortality in this fire, the desert tortoise and the saguaro. Recurrent fires in this ecosystem could lead to extirpation of species not adapted to fire (Búrquez-Montijo et al. 2002, Esque and Schwalbe 2002).

Exotic plants often establish themselves in disturbed areas, such as roads, trails, campgrounds, picnic areas, parking lots, and construction sites. Once established, they spread into undisturbed areas. Overall, native habitat is lost and soil erosion increases, leading to long-term changes in plant communities and loss of biodiversity. In the Sonoran Desert, there are approximately 240 exotic plant species, which is approximately 11% of the Sonoran Desert flora (Wilson et al. 2002). Approximately one-quarter of the 240 exotic plant species are considered established and reproducing (Wilson et al. 2002). It has been suggested that one third of the native plants that are threatened or endangered have achieved that status as a direct result of exotic plant species (Wilcove et al. 1998). Exotic plant species are having significant negative impacts on native ecosystems in Saguaro NP, as well as throughout the country.

## PLAN GOALS

The goals of the Invasive Exotic Management Plan are to:

- Prevent any new exotic species from becoming established.
- Immediately treat any new infestations of the 13 species previously found in and currently eradicated from the park.
- Eradicate 17 species which are the most invasive and pose the greatest threat to the biological diversity within the park (five of these are on the AZ noxious weed list).
- Eradicate, contain, or control the spread of 63 known invasive species in future years as time, funding, and scientific knowledge allow.

Saguaro NP proposes to be proactive versus reactive by stopping invasive exotic plants before they become a serious threat to the park's natural and cultural resources. However, the park will also use the method with the least impact on the park's resources. When the use of inorganic (synthetic) herbicides is warranted, Saguaro NP proposes to use the least toxic herbicide effective for that particular species.

## PLAN'S PROPOSED ACTIONS

This Plan calls for eight proactive strategies to achieve the goal of eradication and/or reduction of invasive exotic species in Saguaro NP. These actions are:

- Inventory and monitor invasive exotic plants in Saguaro NP.
- Prioritize exotic plants to be controlled.

- Identify control techniques most appropriate for each species.
- Apply the most appropriate control techniques for each species.
- Monitor effectiveness of control efforts.
- Prevent new infestations by monitoring invasive exotic plant pathways.
- Inform the public about Saguaro NP exotic plants and control methods.
- Work with adjacent landowners and local, county, state and federal agencies.

Saguaro National Park would use a proactive, integrated approach to manage exotic plant infestations, including mechanical, cultural, chemical, low risk, and biological control techniques. The project area includes both wilderness and other specially designated areas. This document would have a sunset date of eight years.

## DEFINITIONS

Several terms are defined to facilitate understanding of this Plan and EA:

**Native Plant** – The NPS defines native plants as all species that have occurred or now occur as a result of natural processes on lands designated as units of the national park system. Native species in a place are evolving in concert with each other (NPS 2001b). A goal of the NPS is to perpetuate native plants and animals as part of the natural ecosystem.

**Exotic Plant** – The NPS defines an exotic species as those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Because an exotic species did not evolve in concert with the species native to the place, the exotic species is not a natural component of the natural ecosystem at that place (NPS 2001b). Synonyms – non-native, alien, invasive exotic.

**Invasive Exotic Plant -** An aggressive non-native plant that is known to displace native plant species. Invasive exotic species are unwanted plants which are harmful or destructive to man or other organisms (Executive Order 13112).

**State Listed 'Noxious Weeds' –** The term 'noxious' is a legal designation. Noxious weeds are invasive exotic plants prohibited or restricted by Arizona Law. Several of the invasive exotic plants known to occur in Saguaro National Park fall into this category (Table 2). Transporting seed or parts of these plants, or allowing them to seed on one's property is prohibited. Saguaro does propose to also control invasive exotic plants that are not on the State Noxious Weed List because they pose a threat to the park's natural resources.

**Integrated Pest Management (IPM) -** A decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment (NPS 2001b). A combination of multiple control techniques may be the most effective means for controlling a particular pest species.

**Proposed Integrated Pest Management Control Techniques:**

**Mechanical**: Using tools to remove plants by mowing, digging, and cutting seed heads and plants. Tools may include picks, shovels, string-trimmers, mowers, etc.

**Cultural**: Providing competition, stress, or control of exotic species by planting native vegetation or burning exotic plants. It also includes educating visitors and staff about the exotic plants to reduce spread of invasive plant species.

**Chemical**: Using inorganic (synthetic) herbicides to kill or severely stress invasive exotic plants.

**Biological**: Using insects, mammals, or pathogens to stress exotic plants.

**Low Risk Methods**: Using hot water (steam) to scald exotic plants, plastic sheeting to smother plants, or using organic chemicals that may contain biodegradable soap, acetic acid, or sugar compounds.

## 1. INVENTORY AND MONITOR INVASIVE EXOTIC PLANTS AT SAGUARO NP

Out of the approximately 1,200 plant species found at Saguaro, 80 species are not native to this region. Of these, 17 species are of particular concern because they are aggressive, invasive, and have the potential to displace native plants or hybridize with the native species (Table 1). For the 17 species of concern, infested sites range in size from a single plant to a population of one species covering several acres. In all cases, the exotic plant infestations do not involve 100 percent of the ground, so actual control efforts for invasive exotic plants may be confined to a smaller area than reflected in the total infested acres (Table 5).

**Table 5. Estimated number of acres infested by selected exotic plants at Saguaro National Park. See text for description of surveys completed.**

| Species | #Acres | Estimation method* |
|---|---|---|
| *Agrostis semiverticillata* | 6.16 | Surveyed infested acres |
| *Avena fatua* | 15.55 | Surveyed infested acres |
| *Brassica tournefortii* | 1.59 | Surveyed infested acres |
| *Bromus rubens* | 142.5 | (26,000 acres below 4500' @RMD +31,000 @TMD) X (.25%) |
| *Cenchrus longispinus* | 0.01 | Surveyed infested acres |
| *Centaurea melitensis* | 16.75 | Surveyed infested acres |
| *Cynodon dactylon* | 15.92 | Surveyed infested acres |
| *Dimorphotheca sinuata* | <0.01 | Surveyed infested acres |
| *Echinochloa colonum* | 1.03 | Surveyed infested acres |
| *Echinochloa* spp. | 0.03 | Surveyed infested acres |
| *Eragrostis cilianensis* | 0.65 | Surveyed infested acres |
| *Eragrostis curvula* | 2.34 | Surveyed infested acres |
| *Eragrostis echinochloidea* | 6.16 | Surveyed infested acres |
| *Eragrostis lehmanniana* | 65 | (26,000 acres below 4500' @RMD) X (.25%) |
| *Erodium cicutarium* | 12.99 | Surveyed infested acres |
| *Hordeum murinum* | 12.08 | Surveyed infested acres |
| *Lactuca serriola* | 1.76 | Surveyed infested acres |
| *Malva parviflora* | <0.01 | Surveyed infested acres |
| *Marrubium vulgare* | 2.47 | Surveyed infested acres |
| *Melilotus indicus* | 0.86 | Surveyed infested acres |
| *Nerium oleander* | <0.01 | Surveyed infested acres |
| *Pennisetum ciliare* | 172.51 | Surveyed infested acres |
| *Pennisetum setaceum* | 108.72 | Surveyed infested acres |

| | | |
|---|---|---|
| *Phalaris canariensis* | 12.33 | Surveyed infested acres |
| *Phalaris minor* | 2.52 | Surveyed infested acres |
| *Polypogon monspeliensis* | 28.16 | Surveyed infested acres |
| *Rhus lancea* | <0.01 | Surveyed infested acres |
| *Rhynchelytrum repens* | 34.16 | Surveyed infested acres |
| *Rumex crispus* | 6.16 | Surveyed infested acres |
| *Salsola australis* | 0.93 | Surveyed infested acres |
| *Sisymbrium irio* | 7.64 | Surveyed infested acres |
| *Sonchus asper* | 0.004 | Surveyed infested acres |
| *Sorghum halepense* | <0.01 | Surveyed infested acres |
| *Tamarix* spp. | 0.14 | Surveyed infested acres |

*****Infested acres only includes actual area infested by a particular species (e.g. 30' x 150' = 4,500 sq.ft. = 0.10 acres infested). It does not take into account the percent cover for the infestation.

Compiled from Saguaro NP files and Halvorson and Guertin 2003.

**Tools:** Saguaro NP currently uses Global Positioning System (GPS) equipment to locate and Geographical Information System (GIS) software to map invasive exotic plants. Figures 2-4 were developed using the park's GPS and GIS capabilities. Maps showing specific locations of invasive exotic plants are maintained in the Division of Science and Resources Management. Data collected exceeds the basic minimum requirement for North American Weed Management Association. In addition, a model was developed for one species of concern (buffelgrass) to depict potential distribution (Ward 2003). This model indicates that while buffelgrass currently occupies <1% of the Sonoran desertscrub communities at Saguaro NP, it could occupy up to 32% of the communities (Ward 2003). Remote sensing using satellite imagery to locate and map infestations, or additional spatial modeling may also be used in the future.

**Inventory and Monitoring:** Park staff and volunteers conduct invasive exotic plant surveys every year, documenting species present and population size for the most aggressive species. Data collected on exotic plant infestations meet the North American Weed Management Association standards (NAWMA 2004). The annual surveys include many road shoulders and hiking trails in the park, especially at the lower elevations. Several intensive surveys were completed to target specific species and areas since 1992. This data is available as paper and electronic files in the Division of Science and Resources Management. Much of this data has been incorporated into Figures 2-4. While the park has not had 100% of its land surveyed for exotic plants, the common infestation corridors (roads, trails, major low elevation drainages) have been surveyed.

**Ongoing survey and monitoring efforts include:**

Currently there are 53 permanent vegetation monitoring plots in the Sonoran Upland habitat. These plots are monitored twice a year (to capture the spring and summer annuals), every other year so that half of the plots are read twice each year (NPS 2003b). These plots were randomly selected and will be used to document changes in vegetation over time in the Sonoran desertscrub communities.

Saguaro NP's Fire Effects Monitoring Program has established 71 fire effects plots ranging in elevation from 5,000 to 8,600 feet. The Fire Effects Staff is instructed to notify the Division of Science and Resources Management if any exotic plants are encountered, or if monitoring detects an increase or decrease in the number of exotic plants after a prescribed or wildland fire.

The park has taken limited action on the species listed in Table 1, and continues to monitor areas where exotic plants have been removed. Locations where exotics plants are removed are retreated until the exotic plant species of concern are no longer found there, and then monitored for at least two additional years to verify eradication at that site. The exotic plant species that are not currently targeted for

immediate control or eradication (Table 2) will be monitored and may be controlled in the future if time, funding, and scientific knowledge are available.

## 2. PRIORITIZE EXOTIC PLANTS TO BE CONTROLLED

Saguaro NP prioritizes invasive exotic plants for control based on plant assessments and rankings by NatureServe (2004). Saguaro NP also relies on new information as it becomes available about the invasive tendencies of species, and considers state and national priorities when setting park priorities. The species identified for immediate control in Table 2 are considered high priority for control at Saguaro NP.

High priority for control will be given to exotic plants that:

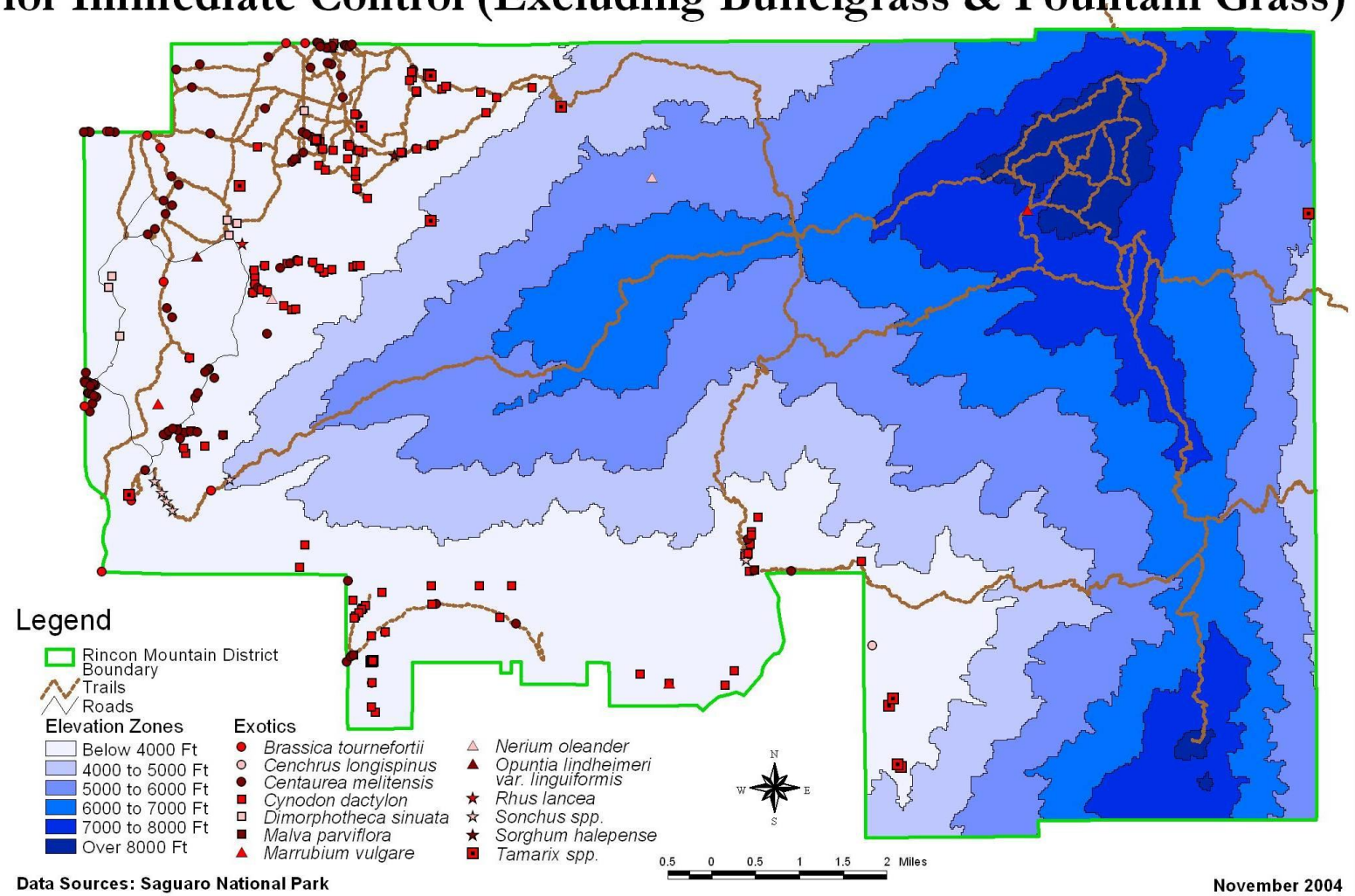
- Affect the biodiversity of park resources.
- Threaten rare or endangered species in the park (plant or animal).
- Occur within the Protected Natural Areas in the park.
- Occur in developed areas that are 'hot spots' or pathways (roads, trails) for infestations to spread.
- Are listed by the state or county as a noxious weed or as a high priority for eradication or control.
- Occur within ¼ mile of the park boundary and pose a threat to spread to neighboring lands.
- Are new infestations of new exotic plant species, having never occurred in the park or having been successfully eradicated from the park previously.
- Occur in areas where seed can be rapidly dispersed to other areas of the park (riparian areas).

Saguaro National Park
Arizona

# Figure 2

National Park Service
U.S. Department of the Interior

## Rincon Mountain District Known Locations of Exotic Species for Immediate Control (Excluding Buffelgrass & Fountain Grass)




Data Sources: Saguaro National Park

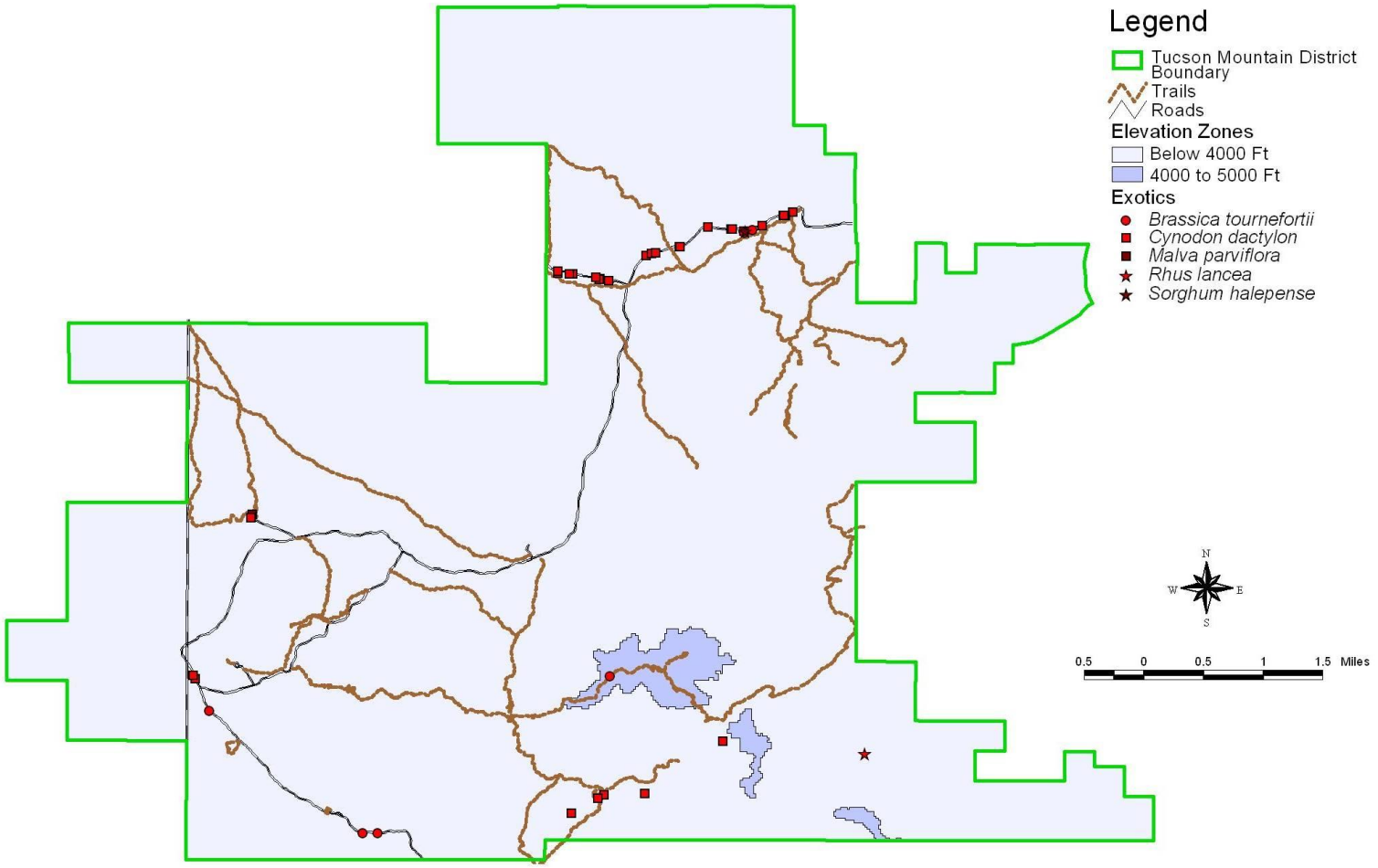
November 2004

Saguaro National Park
Arizona

# Figure 2

National Park Service
U.S. Department of the Interior

## Tucson Mountain District Known Locations of Exotic Species for Immediate Control (Excluding Buffelgrass & Fountain Grass)




Data Sources: Saguaro National Park

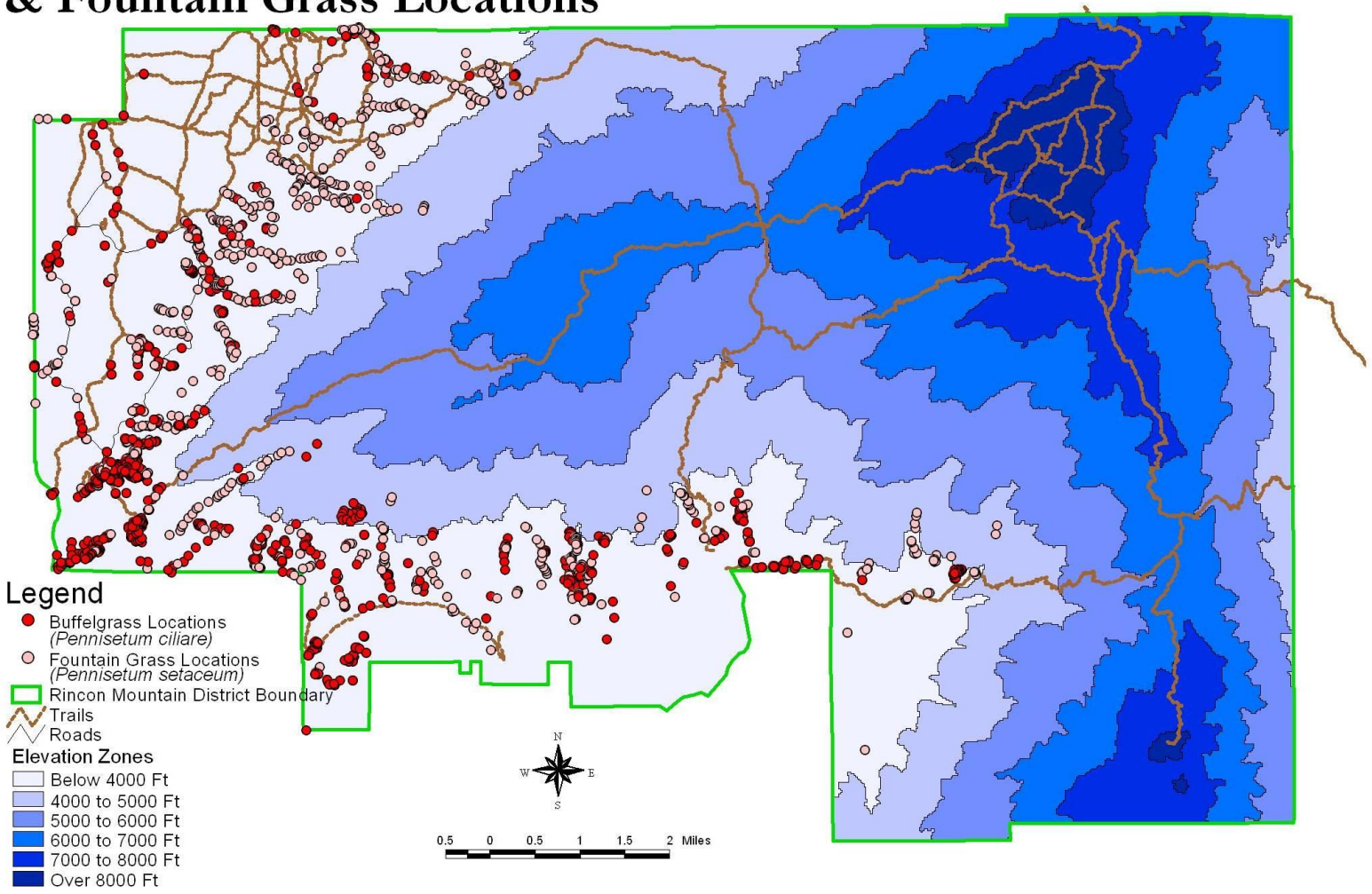
November 2004

Saguaro National Park
Arizona

# Figure 3

National Park Service
U.S. Department of the Interior

## Rincon Mountain District Buffelgrass & Fountain Grass Locations




Data Sources: Saguaro National Park

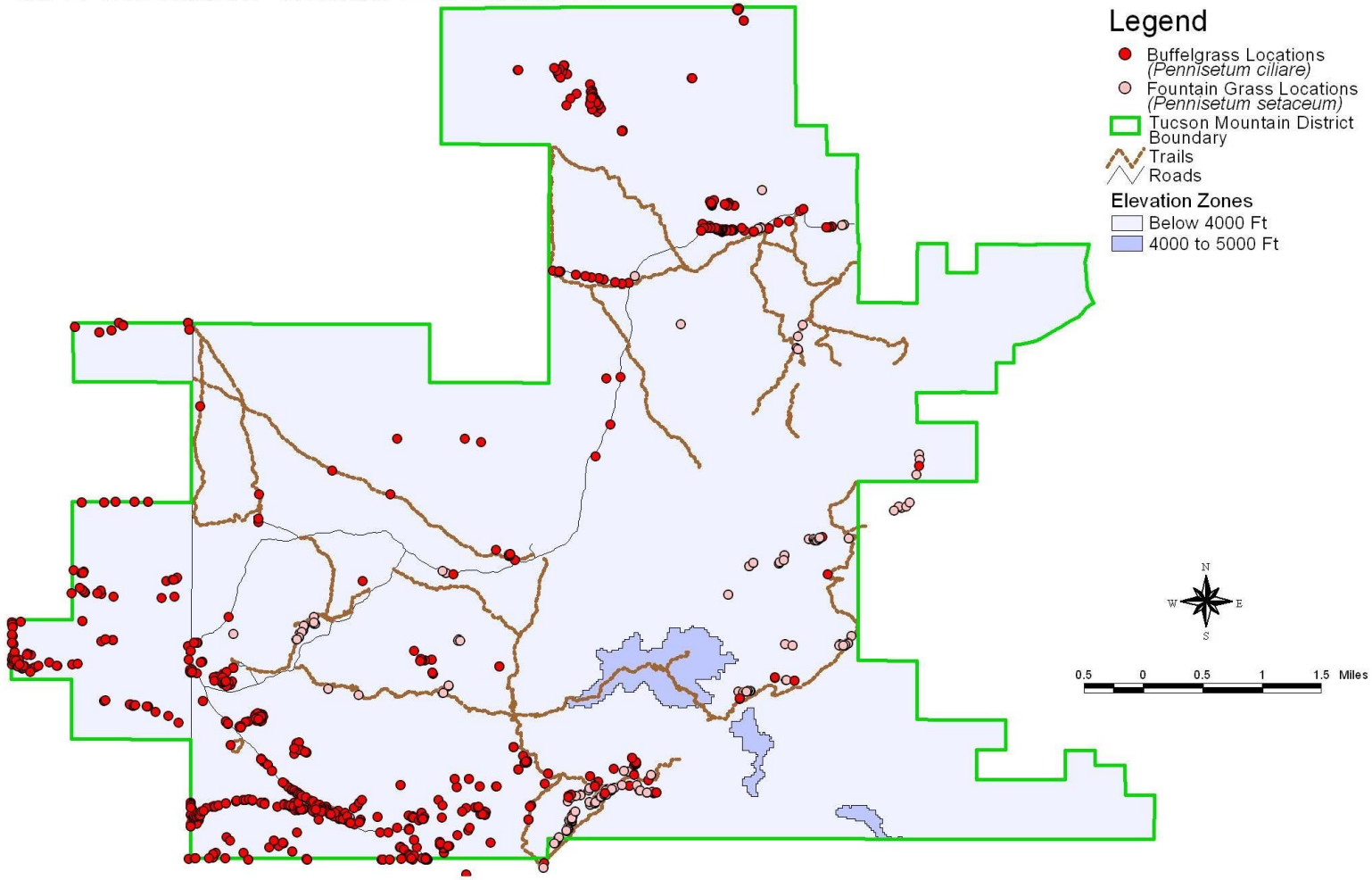
November 2004

Saguaro National Park
Arizona

# Figure 3

National Park Service
U.S. Department of the Interior

## Tucson Mountain District Buffelgrass & Fountain Grass Locations




Data Sources: Saguaro National Park

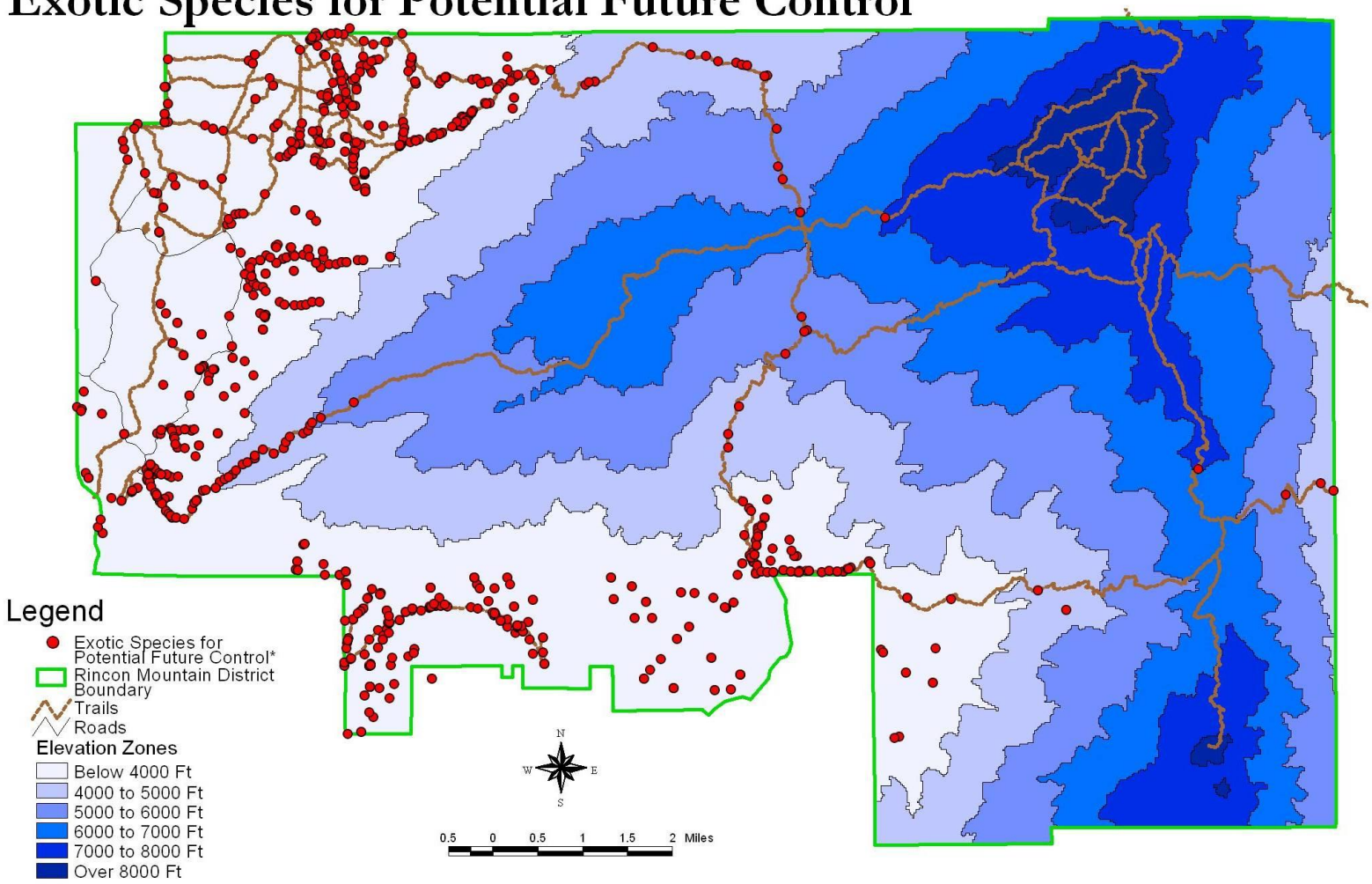
November 2004

Saguaro National Park
Arizona

# Figure 4

National Park Service
U.S. Department of the Interior

## Rincon Mountain District Known Locations of Exotic Species for Potential Future Control




Data Sources: Saguaro National Park

*Due to the high number of exotic species for potential future control, they are all displayed with one symbol. A list of the various species can be found on page xx.

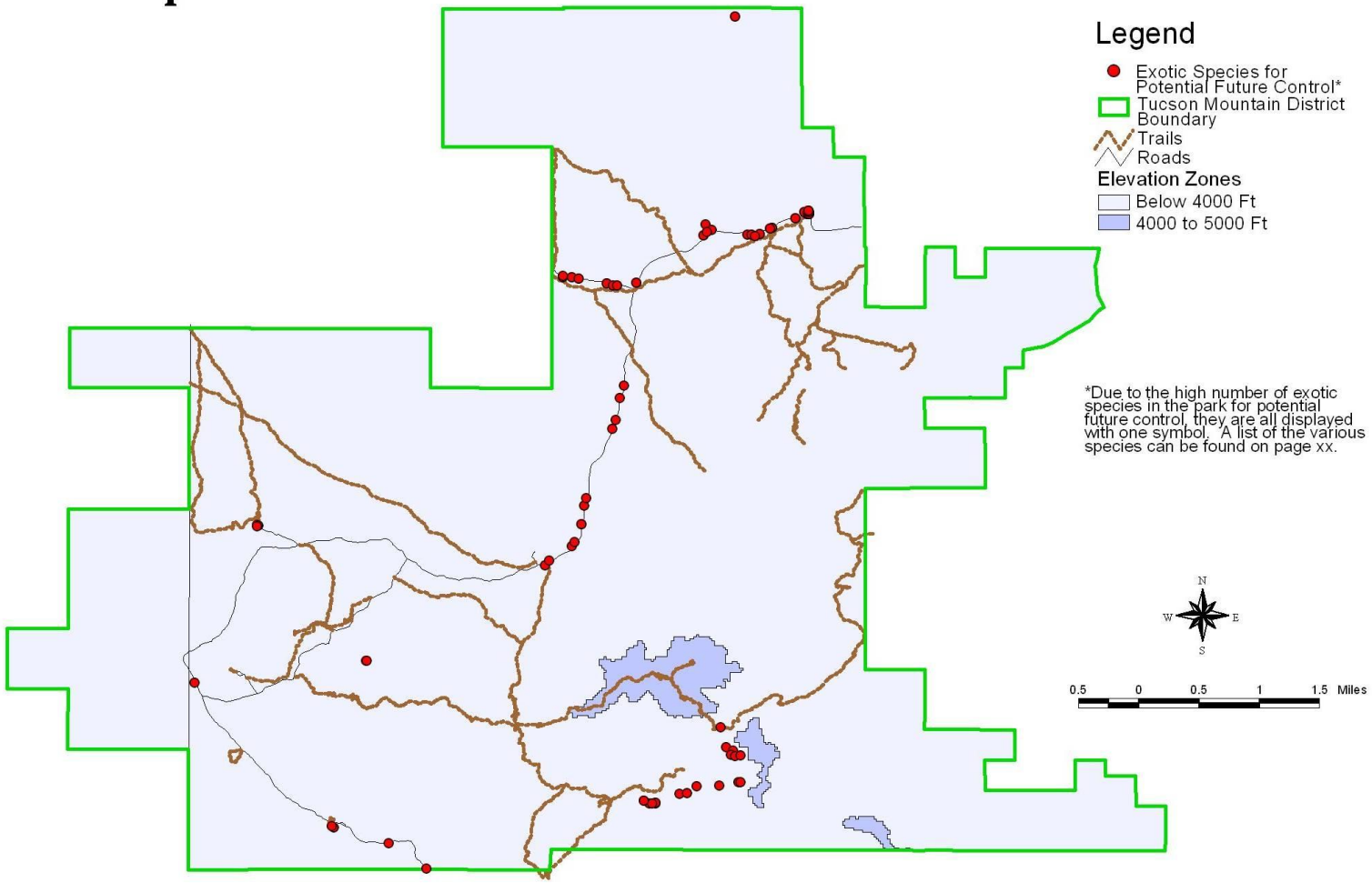
November 2004

Saguaro National Park
Arizona

# Figure 4

National Park Service
U.S. Department of the Interior

## Tucson Mountain District Known Locations of Exotic Species for Potential Future Control




Data Sources: Saguaro National Park

November 2004

### 3. IDENTIFY CONTROL TECHNIQUES THAT ARE MOST APPROPRIATE FOR EACH SPECIES.

Control techniques will be selected that achieve maximum effectiveness in eradication while minimizing risks to natural resources, cultural resources, and the human environment. They will be identified as appropriate for invasive exotic plant control if they possess the following characteristics:

- The control technique must be effective at killing the invasive exotic plant.
- The control technique poses little or no risk to native vegetation, wetlands, wildlife, or other natural resources.
- The control technique poses little or no risk to cultural resources.
- The control technique poses little or no risk to the human environment or to the safety of park visitors or park employees.
- The control technique must be cost-effective to implement.

Five options are available to managers in controlling invasive exotic plants: mechanical, cultural, chemical, low-risk, and biological methods (defined above). The options can be used alone or in combination for the prevention, eradication, control, or containment of a particular species. The process of evaluating which technique(s) is/are most appropriate for each species is known as Integrated Pest Management (IPM).

Within the context of this plan, prevention means minimizing introduction of an exotic species into the park and is usually combined with eradication to allow for elimination of spot populations as they arise. Eradication means attempting to totally eliminate a species from the park. Control means preventing seed production throughout a target patch and reducing the area covered by a species, whereas containment means to prevent the species from expanding beyond the perimeter of the existing patches. Over a period of time a species assigned a control objective will experience a decline in overall population size. The "contain" and "control" strategies are often combined due to different sized populations found in different areas. For some species it may not be possible to limit the spread of the infestation, and it may only be possible to control a portion of the outbreak on high-value sites. An individual population may be assigned a different treatment goal than the species as a whole due to location and resources involved.

Techniques for exotic species control vary in effectiveness. In some cases, a combination of treatments may be necessary to meet control or eradication goals. For example, research currently underway at Saguaro NP indicates that one of the most effective methods for controlling buffelgrass occurs when a mechanical method (cutting or string-trimming) is followed by a chemical application (T. Esque, personal communication). Other effective methods include repeated hand-pulling, which is effective but very expensive, or chemical application without pre-treatment, which leaves a large amount of standing biomass that is not natural for the Sonoran desertscrub (T. Esque, personal communication). Data from this project will include native plant recovery and the data will be used to determine which method is the most effective in terms of eradicating the exotic plant species and in terms of recovery of the native plant community.

Information from research will be used where appropriate to guide control priorities and control methods. For example, research by the USGS and the University of Arizona is currently underway to determine the most effective method of controlling buffelgrass and the costs associated with the different methods of control. This information will be used to help guide the control efforts at the park (see above paragraph). Other research studies that may help guide future control include: a study being completed on the genetics of fountain grass, a study examining the differences in soil nutrients below buffelgrass and below a native grass, and a study examining the nutrient (N and C) levels in buffelgrass infestations and non-infested areas.

Exotic plant infestations in high visitor use areas (picnic areas, trailheads, campgrounds) will be controlled with mechanical, low-risk, or cultural methods first. If these methods prove ineffective, then chemical methods would be considered. If chemical methods are selected for high visitor use areas, notice of the intent to treat would be posted on-site, at the visitor centers and on the park's website. In addition, the area would be closed during treatment until re-entry is allowed and the area will remain signed for a minimum of double the half-life of the herbicide.

In all cases, the effectiveness of mechanical, cultural, and low-risk methods will be evaluated before inorganic chemical control or biological control is proposed.

Saguaro NP will continue to make a good faith effort to evaluate treatment options and ensure all environmental compliance standards are met. Saguaro NP will review any new relevant scientific literature and references to ensure control techniques selected are biologically sound.

Some IPM techniques have the potential to harm humans. Injuries can occur with the use of string trimmers, hand-tools, and scalding hot water. Herbicides can impact human health, particularly for those with Multiple Chemical Sensitivity (MCS). Saguaro NP would like to use both organic and inorganic herbicides on invasive exotic plants in order to achieve effective control and to keep invasive exotic plant populations from spreading. The types of chemicals proposed for use on invasive exotic plants are described in Appendix D. This table includes information on the herbicide behavior in soil and air, impacts to plants, impacts to non-target species, impacts to human health, and other concerns.

Some species may require more than one application of herbicide. Saguaro NP's preference is to only do one application of an inorganic herbicide in any one year verses multiple applications, but two species (buffelgrass and fountain grass) may require two applications in any one year to eliminate seed production and eradicate populations. For species requiring chemical control, applications could occur once or twice a year over several years until an invasive exotic is brought below the established threshold level. To improve the efficacy of an herbicide, other IPM techniques, such as string-trimming or using chainsaws, may be used before the chemical is applied (Appendix E outlines the known control methods).

Saguaro NP will identify a control technique that poses minimal or no impact to known cultural resources. Ground disturbing activities, such as mechanical removal of plants, would not be appropriate for exotic plant removal where cultural resources are present (e.g., lithic scatters). In these locations, chemical control may be the preferred method.

Many exotic plants occur in ephemeral drainages due to increased water availability in those areas. In drainage bottoms, string-trimming and/or chemical control may be the preferred method to reduce the amount of soil disturbance. Any chemicals used in ephemeral drainages would be labeled for aquatic use to ensure protection of those resources, even in the absence of surface water.

Cost is not the driving factor in selecting appropriate control techniques for exotic plant control, but would be considered. Based on cost estimates from the USGS buffelgrass study, it costs approximately $7,000 to treat one acre of buffelgrass by hand-pulling and costs $270 to treat with one acre with herbicides. While this is a significant difference, some areas would still be treated by hand-pulling due to location or availability of volunteers. This plan and environmental assessment would allow the park to use an adaptive management strategy to treat invasive exotic plants in the park. It will allow the park to use all forms of control, including chemical control methods, which will allow the park to control or eradicate exotic plant populations more effectively.

## 4. Apply the Most Appropriate Control Technique(s).

Saguaro NP recommends immediately implementing control actions for 17 invasive exotic plants (See Tables 1 and 2). If it is determined that eradication is not feasible, the objective will be to suppress the exotic plant population below the threshold level, or conduct limited eradication or containment in sensitive areas of the park (NPS 2001b). For example, in the case of tamarisk, the threshold level is reached when only one plant is found and an herbicide may be used. In the case of cow's tongue prickly pear, the threshold level is reached when one plant is found, yet one plant does not warrant herbicide use since a single plant can be controlled by hand pulling or digging.

The six herbicides and the marker dyes proposed for use in this plan and EA have Risk Assessments already completed by the USFS (SERA 1995, 1997a, 1997b, 1998, 1999, 2001, 2003a, 2003b). These documents are comprehensive risk assessments of the human health effects and ecological effects of using herbicides in vegetation management programs. See Appendix D for a brief summary of each herbicide. These Risk Assessments are available in the Restoration Program office and will be reviewed regularly to ensure staff members are familiar with the information in these documents.

When herbicides are used for exotic plant control, marker dyes will be mixed with the herbicide to allow the certified applicators a visual confirmation of appropriate application quantities and conditions. The dyes will also reduce the likelihood of herbicides contacting non-target plant species.

Over the planning horizon of eight years, it is estimated that less than one percent of the total park lands would be treated by any of the methods described in this document. Repeated treatments or re-treatments would be necessary for most targeted species because seeds in the soil can be viable for multiple years. Therefore, recurring actions would be necessary until the desired control objective is reached.

Adaptive management is part of the proposed action. Exotic plant infestations are dynamic; even the most complete inventory will never completely cover the potentially infested area and will quickly be out of date. New infestations and new species are the highest priority for treatment. New methods or materials may become available that are better suited to a situation than those currently recognized. Adaptive management allows flexibility in changing treatment methods, such as adjusting the timing or frequency of treatments. Adaptive management includes the following:

- Treatments of infestations of invasive exotic plants that may become established but which are not currently identified on the species list or known to occur in the park;
- The use of similar formulations to the herbicides approved with this plan may be used if it falls under the scope and impacts discussed in this document.
- If prescribed management fails to result in desired outcome, alternative strategies will be developed, and management will be adapted until the desired conditions are achieved. New alternative strategies will be reviewed on a site-specific and case-by-case basis. If it is demonstrated through analysis that the environmental impacts of a new approach fall outside the impacts as disclosed in this document, then additional environmental analysis will be undertaken under NEPA.

## 5. Monitor the Effectiveness of Control Efforts.

Monitoring is an essential strategy in evaluating control techniques. Saguaro NP will continue to monitor the occurrence of invasive exotic plants and update the information annually. The park will continue to monitor locations where exotic plants are removed.

Currently there are 53 permanent vegetation monitoring plots in the Sonoran Upland habitat. These plots are monitored twice a year (to capture the spring and summer annuals), every other year, so that half of the plots are read twice each year (NPS 2003b). These plots were randomly selected and will be used to document changes in vegetation over time in the Sonoran desertscrub communities. When exotic plants are found on these plots, the Restoration Program leader is notified and control actions will be taken for plants listed for immediate control in Table 2.

Saguaro NP's Fire Effects Monitoring Program has established 71 fire effects plots ranging in elevation from 5,000 to 8,600 feet. The Fire Effects Staff is instructed to notify the Division of Science and Resources Management if any exotic plants are encountered, or if monitoring detects an increase or decrease in the number of exotic plants after a prescribed or wildland fire.

The park has taken limited action on the species listed in Table 1, and continues to monitor areas where exotic plants have been removed. Locations where exotics plants are removed are retreated until the exotic plant species of concern are no longer found there, and then monitored for at least two additional years to verify eradication. The exotic plant species that are not currently targeted for control or eradication (Table 2) will be monitored and may be controlled in the future if time, funding, and scientific knowledge are available.

Scientific research may also be used to monitor effectiveness of control methods. For example, research by the USGS and the University of Arizona is currently underway to determine the most effective method of controlling buffelgrass and the costs associated with the different methods of control. (See #3 above for further information.)

### 6. Prevent New Infestations by Monitoring Exotic Plant Pathways.

Exotic plants establish themselves in developed areas and in biologically diverse habitats. Saguaro NP will closely monitor exotic plant pathways, including road shoulders, trailheads, trails, picnic areas, and construction sites.

To prevent new infestations, Saguaro NP will employ "Best Management Practices," including:

- Ensure fill and gravel used in park construction and maintenance activities is free of exotics listed in Table 2.
- Clean vehicles and heavy equipment of invasive exotic plant seeds before entering park.
- Construction sites will be closely monitored for 3-5 years following construction to ensure any exotic plants are removed promptly.

### 7. Inform the Public about Exotic Plants and Control Measures.

Saguaro NP will increase efforts to inform the public about invasive exotic plants and control measures. The following communication plan was developed and is designed to:

- Inform the public about local, regional, and national issues regarding invasive exotic plants;
- Inform the public about invasive exotic plant control measures in Saguaro NP, especially herbicide use;
- Inform neighbors within ¼-mile of any exotic plant infestation to be chemically treated prior to treatment;
- List locations to be treated with herbicides on the park's website and at the park's visitor centers; and,
- Encourage two-way communication between NPS and the public on matters regarding invasive exotic plant management in Saguaro NP.

## 8. Work Closely with Adjacent Landowners to Achieve Common Goals of Exotic Plant Management.

The spread of invasive exotic plants throughout Arizona, the American west, and the nation poses a serious environmental and economic threat to public land, ranchland, farmland and private property. Saguaro NP has joined with other federal, state, and local government agencies, homeowner associations, private landowners, and non-governmental organizations to develop joint strategies for curbing this silent threat.

Saguaro NP will continue to work with volunteers in controlling invasive exotic plants by mechanical or cultural means. Volunteers have helped to reduce the number of acres infested with invasive exotics. Approximately 550 hours of volunteer time were devoted to controlling invasive exotic plants in 2003 at Saguaro NP.

Saguaro NP will continue to exchange information with surrounding landowners, both private and public, in an effort to eradicate or reduce exotic plant populations along shared boundaries. Education and awareness are an integral part of the long-term control strategy for invasive exotic plants.

# CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES

## METHODOLOGY

Potential impacts are described in terms of type (are the effects beneficial or adverse?), context (are the effects site-specific, local, or even regional?), duration (are the effects short-term or long-term?), timing (is the project seasonally timed to avoid adverse effects), and intensity (are the effects negligible, minor, moderate, or major). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this environmental assessment/assessment of effect.

In addition, National Park Service's Management Policies (2001b) require analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within a park, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. A determination on impairment is made in this section for natural and cultural resource topics.

## CUMULATIVE IMPACT SCENARIO

The Council on Environmental Quality (CEQ) regulations, which implement the National Environmental Policy Act of 1969 (42 USC 4321 *et seq*.), require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and preferred alternatives.

Overall impacts, as stated in the 'Conclusion' section under each impact topic, were determined by combining the impacts of the no action alternative or the preferred alternative (as appropriate) with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at Saguaro National Park and the surrounding region. The following are the cumulative impacts that are considered in this document.

Park Construction Projects at the RMD and the TMD

Several upcoming projects are planned including: replacement of the headquarters septic system (RMD, summer 2004), intersection improvements at the Sandario/Kinney Road intersection (TMD, fall 2004), chip seal Kinney Road (TMD, spring 2005),repaving Cactus Forest Loop Drive (RMD, summer 2005), and trail maintenance projects (on-going). These construction projects have the potential to bring in or locally increase exotic plant species. Mitigations and funding are included in each of the projects to use weed seed-free fill and aggregate materials, revegetation projects where vegetation is being impacted, and for exotic plant surveys and removal efforts for a minimum of two years following each project.

Prescribed and Naturally-ignited Fires at the RMD

The park has nearly completed the new Fire Management Plan and the associated Environmental Impact Statement. When complete, this plan will allow fires at the higher elevations to burn naturally, if they fall within specific prescription parameters. It also allows for prescribed burns (intentionally ignited) at the higher elevations, as needed. Fires at the lower elevations would continue to be suppressed because vegetative communities at the lower elevations are not adapted to fire. Allowing fire to return to the high elevations will improve the health of the forests, which will reduce the risk of exotic plant infestations.

Rapid Urbanization of the Greater Tucson Metropolitan Area

The greater Tucson metropolitan area has a population of approximately 885,000 and is projected to grow to more than 1,000,000 by the year 2009 (Tucson Planning Department 2001). The metro area occupies the 30 miles that separate the two districts of the park and has largely restricted natural open spaces near both districts. Urban and suburban development will continue to bring in a greater number of residents closer to park boundaries. These developments adjacent to the park will, in turn, put more stress on park resources such as wildlife that move across park boundaries or vegetation communities that may be affected by escaped ornamental plants. As the population of Tucson continues to grow and open spaces continue to diminish, the park would likely experience more visitation and crowding in developed areas.

The Sonoran Desert Conservation Plan

The Sonoran Desert Conservation Plan (SDCP) has been developed by Pima County (Huckelberry 2000). It is a long-term plan to guide growth and development in Pima County. The SDCP examined the habitat needs of 56 vulnerable species as well as archeological sites, historic resources, etc. and developed a map of high priority conservation lands. The plan evaluates where development should occur based on natural and cultural values. The plan has been adopted by the county and a public referendum held in May 2004 approved the sale of bonds to fund land acquisition as outlined in the plan. When fully implemented, it will provide a reserve system for conservation of the most biologically and culturally valuable lands in Pima County. In the SDCP, many of the lands surrounding both districts of Saguaro NP are designated as

multiple use or recovery management areas. Therefore, the proposed land use surrounding the park will focus on the conservation, restoration, and enhancement of natural communities (Huckelberry 2002).

# SOILS

### AFFECTED ENVIRONMENT

Because of the region's semi-arid climate, soils are not well developed in southern Arizona. The ground surface of much of the Rincon Mountains consists of bedrock or regolith. A thin veneer of alluvium covers pediment surfaces along the margins of the range. This alluvial fill thickens to tens of feet along larger drainages, such as Rincon Creek, and has been cut into terraces by stream entrenchment in places. Aridisols with calcium carbonate (caliche) concentrations have developed on this deeper alluvium. At the highest elevations, where the natural vegetation is coniferous forest, thin soils with distinctive soil horizons have developed.

The Tucson Mountains themselves are composed of intrusive plugs, flow and welded tuffs, and sedimentary rocks; the lower slopes of the mountains are covered by terrace deposits or other alluvium, sometimes up to 400 feet thick (NPS 1995). The soils of the TMD mountain slopes are shallow, coarsely textured and well-drained, and soils of the bajadas are alluvial (NPS 1995). Soils become progressively finer with more sand and clay from bedrock to bajada to flats.

### METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to soils were derived from the available soils information (USDA 2002) and park staff's past observations of the effects on soils from visitor use, construction activities, and exotic plant removal. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | Soils would not be affected or the effects to soils would be below or at the lower levels of detection. Any effects to soils would be slight and erosion would not be noticeable. |
| Minor | The effects to soils would be detectable. Effects to soil area, including soil disturbance and erosion, would be small and localized. Minimal soil loss would occur. Mitigation may be needed to offset adverse effects and would be relatively simple to implement and likely be successful. |
| Moderate | The effect on soils would be readily apparent and result in a change to the soil character over a relatively wide area, soil disturbance over a wide area, or erosion that extends beyond the project site and/or results in some soil loss. Mitigation measures would be necessary to offset adverse effects and likely be successful. |
| Major | The effect on soils would be readily apparent and substantially change the character of soils over a large area, and substantial erosion would occur resulting in a large soil loss. Mitigation measures to offset adverse effects would be needed, would be extensive, and their success could not be guaranteed. |

Soil impacts would be considered short term if the soils recover in less than three years and long term if the recovery takes longer than three years.

### IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** Under this alternative, exotic plant species would be primarily controlled by mechanical methods. Locations with large infestations would receive more soil disturbance due to mechanical control when compared to small infestations. The localized soil disturbance from mechanical removal of exotic plants could reduce soil stability until plants have reestablished on the disturbed sites. This would be minimized by tamping the soil back into place after removal of the exotic plants. The exotic plant infestations would not be effectively managed under this alternative because of the large amount of time it takes to mechanically remove populations; therefore locations that did not receive treatment could see changes in soil stability and nutrient availability when compared to soils with native vegetation. The no action alternative would result in minor, localized, short-term and long-term, adverse impacts to soils.

**Cumulative Impacts.** Park construction projects would have localized impacts on soils. The increase in urbanization near the park's boundary would continue to impact soils. Soils would be disturbed through grading and building construction. Some soils will be restored through landscaping, but others will be covered with concrete or asphalt. The SDCP will protect high priority habitats from development which would, as a result, protect soils. Allowing fires in Saguaro NP to burn naturally where and when it is appropriate will have impacts on soils depending on the intensity of the fire. As the natural fire interval is returned to the system, the intensity of fires should decrease, which would result in a decrease in the impact to soils. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short- and long-term, minor, adverse impacts on soils.

**Conclusion.** Impacts to soils under this alternative would be adverse, short and long term, minor, and localized because exotic plant infestations would be controlled by mechanical means which results in greater soil disturbance. The cumulative effects of the past, present, and reasonably foreseeable future actions would have long-term, minor, adverse impacts on soils. The combined impacts of the no action alternative and the cumulative impacts would have long-term, minor to moderate, adverse impacts on soils.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to soils from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF THE PREFERRED ALTERNATIVE

**Impact Analysis.** Using an integrated approach to manage exotic plant infestations will allow the park to minimize the amount of impact caused managing exotic plant populations. The amount of soil disturbance will be much less for the preferred alternative when compared to the no action alternative because we will not rely completely on mechanical control methods.

Mechanical control can be very effective for new infestations of exotic plants and when plants are few in number. The localized soil disturbance from mechanical removal of exotic plants could reduce soil stability until plants have reestablished on the disturbed sites. This would be minimized by tamping the soil back into place after removal of the exotic plants. Mechanical control is expected to have short-term, minor, localized, and adverse impacts on soils.

Chemical control can be very effective for large infestations of exotic plants and for plants with growth habits that make mechanical control methods ineffective. Herbicides used for chemical control can bind with soils or impact soil microorganisms and could have short-term, minor, localized, adverse impacts on soils. This would be mitigated by using application methods like backpack sprayers and cut-stump treatments to minimize the amount of chemical that comes in contact with soils. Impacts to soils would also be mitigated by selection of herbicides that do not persist in the environment. See Appendix D for information regarding herbicide properties and the mitigation section in Chapter 2 for further detail. An integral part of the preferred alternative is the selection of the most appropriate and least toxic method to control an exotic plant infestation.

Cultural control would have a minor, long-term, beneficial impact on soils by returning native vegetation to the soils. Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. Bringing in animals to graze exotic plants could have minor, short-term, adverse impacts on soils. Insects would have no impacts on soils. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods will not impact soils if applied properly. Soil microorganisms may be negatively impacted (especially with the plastic sheeting), but the impacts would be short-term, localized, and negligible.

In addition, by removing exotic plant species, native plant communities will be restored. This will have positive effects on soil nutrient availability and cycling, water availability, and soil erosion. Consequently, the preferred alternative will have negligible to minor, short-term, adverse impacts and minor, long-term, beneficial impacts on the soils.

**Cumulative Impacts.** The cumulative impacts would be the same as the no action alternative.

**Conclusion.** Impacts to soils would be less under the preferred alternative due to the ability to select the exotic plant control method that is best for each individual infestation and site. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short- and long-term, moderate, adverse impacts on soils. Overall, the preferred alternative's contribution to the adverse impacts on soils is negligible to minor and short term, but the contribution to the beneficial impacts on soils is minor and long term.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to soils from implementation of the preferred alternative at Saguaro National Park.

# VEGETATION

### AFFECTED ENVIRONMENT

**Rincon Mountain District** (this section adapted from Bowers and McLaughlin 1987). Low elevation Sonoran desertscrub gives way upslope to desert grassland, which in turn interdigitates with pine-oak woodland. Pine-oak woodland gives way to pine-oak forest, which gives way to pine forests, and then gives way to mixed conifer forests on north-facing slopes. The addition and loss of species from 3,000 to 8,600 feet is gradual, leading to many shared species between adjacent plant associations. Small areas of mixed conifer forest occupy north-facing slopes at higher elevations. Riparian forest and riparian

woodland occur locally in canyon bottoms. Wet and dry meadows are found in scattered clearings at high elevations-the former around springs, the latter often on old burns and disturbed sites.

Mountain Wet Meadow. Occurs in the immediate area near springs from 7,400 to 8,000 feet. Dominants include various sedges, rushes and grasses.

Mountain Dry Meadow. Occurs at 8,500 feet. Perennial grasses such as mountain muhly, fringed brome, and rough bentgrass dominate this association. Large stands of bracken fern also occur, usually with perennial western sneezeweed and a range of annual forbs and grasses. Disturbed stands of these ferns may be invaded by sheep sorrel (*Rumex acetosella*), cheatgrass (*Bromus tectorum*), and Kentucky bluegrass (*Poa pratensis*). Dry meadows in the Rincon Mountains are possibly of human or natural origin (i.e. logging or intense fire) and may revert to pine forest without further disturbance.

Mixed Conifer Forest. Occurs from 7,000 to 8,000 feet. Douglas fir is the dominant species in the overstory, with ponderosa pine, southwestern white pine, Gambel's oak, New Mexico locust, and white fir as subdominants. The shrub understory consists of scattered patches of snowberry, mountain spray, Arizona honeysuckle, and raspberry.

Pine Forest. Occurs from 8,000 to 8,666 feet. Ponderosa pine is dominant in this association, sometimes forming pure stands in the Rincon Mountains. Southwestern white pine and Gambel's oak are usually found as subdominants. The shrub layer is composed of scattered snowberry, mountain spray, Arizona honeysuckle, and Fendler's ceanothus.

Pine-Oak Forest. Occurs from 5,300 to 8,000 feet. Pine-oak forest is a highly variable association that blends into pine forest at its upper elevational limit, and into pine-oak woodland at its lower elevational limit. It can be distinguished from either of these by the larger number of oak species, the presence of Chihuahua pine, and its intermediate stature between pine forest (>80 feet tall) and pine-oak woodland (<20 feet tall). The association is dominated by several pine and oak species, often occurring with Arizona madrone and alligator juniper. The shrub layer resembles that of the pine forest at upper elevations, and includes manzanita, beargrass, Wright's silktassel and wait-a-minute bush at lower elevations. A number of perennial grasses are common, and often become dominant in the understory where trees and shrubs are scattered. Horehound (*Marrubium vulgare*) invades disturbed areas in this association.

Pine-Oak Woodland. Occurs from 4,400 to 6,100 feet. Pine-oak woodland (also known as interior chaparral) describes a diverse, heterogeneous community type that ranges from near-100% cover stands of 20-foot-tall pines and evergreen oaks, to more open pinyon-juniper woodland, to chaparral-like stands of shrubby manzanita, silktassel and lower-stature oak. Other important elements in the shrub layer include mountain yucca, beargrass, lemonade berry, shindagger, and occasional succulents like cholla, prickly pear, and agave. The heterogeneous structure of this association contributes to its particularly high diversity of both forbs and grasses.

Desert Grassland. Occurs from 4,000 to 5,000 feet. This association, forming ecotones with pine-oak woodland at its upper edge and desertscrub at its lower edge, is characterized by the presence and dominance of numerous warm-season, perennial bunchgrasses. The most important grasses include various gramas, tanglehead, plains lovegrass, cane beardgrass, wolftail, curly mesquite, and Arizona cottontop, to name a few. Many shrubs and succulents occur in desert grassland such as ocotillo, sotol, shin dagger, wait-a-minute bush, fairy duster, wild cotton, skeletonweed, brickellia, turpentine bush, and a diverse assemblage of cacti. Scattered trees include velvet mesquite, Mexican blue oak, and two species of juniper. Mesquite can occur as a dominant tree, especially where disturbance (i.e. grazing) has been heavy in the past. It is unclear if there are any "true" desert grasslands left at Saguaro National Park (i.e.

large areas of open grass). The several small patches that exist are slowly being encroached upon by shrub and tree species. Important exotics present in this plant community include Lehmann's and Boer's lovegrasses (*Eragrostis lehmanniana, E. curvula* var. *conferta*). Lehmann's lovegrass has invaded thousands of acres of grassland in other natural areas in southern Arizona and is found in the park.

**Note:** The higher (i.e. non-desertscrub) associations of the Rincon Mountains have thus far been spared the kind of large-scale, rapid invasion by exotics that has occurred in similar plant communities further north (e.g. central highlands of Arizona and Colorado Plateau) and within the park's desertscrub at lower elevations. The most problematic **potential** invaders at these elevations include exotic thistles (*Cirsium* spp.), leafy spurge *(Euphorbia esula*), tree of heaven (*Ailanthus altissima*), and starthistles and knapweeds (*Centaurea* spp.).

Desertscrub. Desertscrub occurs from the base of the mountain to about 5,200 feet and is characterized by the large number of cacti and by the drought-deciduous habit of many of the trees and shrubs. Dominants in the overstory include foothills paloverde, saguaro, ocotillo, and velvet mesquite. Common understory plants include canyon ragweed, brittlebush, various cholla species, wolfberry, smoketree, barrel cactus, desert hackberry, creosote bush, fairy duster, whitethorn and catclaw acacia, prickly pear and limberbush. Some of the most problematic weeds found in desertscrub in the park are red brome (*Bromus rubens*), filaree (*Erodium cicutarium*), Sahara mustard (*Brassica tournefortii*), Malta starthistle (*Centaurea melitensis*), fountain grass (*Pennisetum setaceum*), and buffelgrass (*Pennisetum ciliare*).

Riparian Woodland and Riparian Forest. Riparian forest occurs above 5,000 feet and is characterized by Arizona alder, boxelder, and coyote willow. Riparian woodland is highly variable in species composition, typically supporting not only riparian obligate species but also non-riparian species normally found at higher elevations. Dominant riparian-obligate trees include Arizona sycamore, Goodding's willow, velvet ash, Arizona walnut, and Fremont cottonwood. Representative trees and shrubs usually found at higher elevations include ponderosa and Chihuahua pine, silverleaf oak, New Mexico locust, lemonade berry, manzanita, beargrass, barberry, California and hollyleaf buckthorn. Riparian forest and woodland support a diverse array of grasses, sedges and rushes.

By their nature, riparian areas are subject to frequent disturbance, the severity of which increases with decreasing elevation. As such, they tend to be susceptible to invasion by exotic species. Invasive plants that threaten the park's riparian areas include Bermuda grass (*Cynodon dactylon),* giant reed (*Arundo donax),* Johnson grass (*Sorghum halepense),* rabbitsfoot grass (*Polypogon monspeliensis*), tamarisk (*Tamarix* spp.), and wild oats (*Avena fatua*). Fountain grass and buffel grass (*Pennisetum setaceum, P. ciliare*) are often most problematic in low-elevation riparian areas.

**Tucson Mountain District** (This section adapted from Rondeau et al. 1996). The Tucson Mountain District contains plant associations including desertscrub, desert grassland, and desert riparian scrub, which exhibit many similarities to their counterparts in the Rincon Mountains. Higher elevation communities are absent because the highest point in the Tucson Mountains is 4,687 feet elevation.

Desertscrub. This association occurs throughout the Tucson Mountains, from 2,130 to 4,687 feet. Foothills paloverde and saguaro cactus are the dominant species through much of the park, sometimes joined in the overstory by ironwood. Cacti are particularly diverse in association with paloverde and saguaro, and include various chollas, prickly pears, barrels, hedgehog and pincushion cactus. The most important of a diverse array of shrubs include creosote bush, jojoba, limberbush, ocotillo, brittlebush, and several bursages. Creosote bush and jojoba become dominant plants in some areas, often forming monospecific stands. As in the RMD, red brome (*Bromus rubens*), filaree (*Erodium cicutarium*), Sahara mustard (*Brassica tournefortii*), Malta starthistle (*Centaurea melitensis*), fountain grass (*Pennisetum setaceum*), and buffelgrass (*Pennisetum ciliare*) are among the most problematic exotic species.

Desert Grassland. Desert grassland is found in unevenly distributed patches in the TMD and usually includes many desertscrub plants. Warm-season grasses include Arizona cottontop, curly mesquite, green sprangletop, plains lovegrass and a number of gramas. Tanglehead is found in unusual profusion. Other important plants include banana yucca, shin dagger, sotol, turpentine bush, velvet mesquite and wild buckwheat. The most serious invader of this association is Lehmann's lovegrass (*Eragrostis lehmanniana*).

Desert Riparian Scrub. These communities are generally found following lower elevation floodplains and drainages and, as such, are somewhat more mesic than immediately adjacent vegetation communities. These communities are characterized by overstory vegetation consisting of velvet mesquite, desert hackberry, and catclaw acacia. Common shrubs include desert lavender and canyon ragweed. These communities are subject to relatively frequent flooding disturbance and may provide avenues for exotics to spread into the park. Fountain grass and buffelgrass (*Pennisetum setaceum, P. ciliare*) are problematic in these associations.

## METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to vegetation were derived from the available scientific data and literature and park staff's past observations of the effects on vegetation from visitor use, construction activities, prescribed fires, wildfires, and exotic plant removal. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | No native vegetation would be affected or some individual native plants could be affected as a result of the alternative, but there would be no effect on native plant species' populations. The effects would be on a small scale. |
| Minor | The alternative would affect some individual plants and would also affect a relatively limited portion of that species' population. Mitigation to offset adverse effects could be required and would be effective. |
| Moderate | The alternative would affect some individual native plants and would also affect a sizeable segment of the species' population over a relatively large area within the park. Mitigation to offset adverse effects could be extensive, but would likely be successful. |
| Major | The alternative would have a considerable effect on individual native plants and affect a sizeable segment of the species' populations over a relatively large area in and out of the park. Mitigation measures to offset the adverse effects would be required, extensive, and success of the mitigation measures would not be guaranteed. |

Duration of vegetation impacts is considered short term if vegetation recovers in less than three years and long term if the vegetation takes longer than three years to recover.

## IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** Mechanical removal methods may initially allow some exotic plant species to increase due to soil disturbance, particularly if new seedlings are not removed before seed set. Over time, mechanical removal will restore native populations in the areas where it is completed, which will be a long-term, beneficial, minor impact to native vegetation. This is only predicted to be a minor beneficial impact because a limited number of infestations will be treated due to the labor intensiveness of mechanical removal and the size of infestations. Those areas not treated will continue to have adverse,

moderate, long-term impacts on native vegetation. In addition, occasionally an exotic plant is growing right up against a native plant and removing it by mechanical methods may cause injury to the native plant. This would be a negligible, localized impact because it would be a small number of individuals on a small scale. Overall, the no action alternative would have long-term, moderate, adverse impacts on native vegetation.

**Cumulative Impacts.** Park construction projects would continue to have short-term impacts on native vegetation. Native desert vegetation has been and will continue to be lost to the rapid urbanization in the Tucson basin. Increased urbanization, especially near the park boundary, also brings with it the spread of exotic vegetation into the park and other undeveloped lands. The increase in exotic plants and the destruction of native vegetation on developed lands may cause adverse impacts to vegetation in Saguaro NP. This impact may be offset by the conservation of lands associated with the SDCP, which includes most of the land bordering both districts of the park. Allowing fires in Saguaro NP to burn naturally where and when it is appropriate will have impacts on vegetation depending on the intensity of the fire. As the natural fire interval is returned to the system, the intensity of fires should decrease, which would result in a decrease in the negative impact to vegetation. Overall, the return of fire to the higher elevations will have positive, long-term impacts on native vegetation. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short- and long-term, minor, adverse impacts at the lower elevations, and long-term, beneficial, moderate impacts to native vegetation at the higher elevations in Saguaro NP.

**Conclusion.** The no action alternative will have adverse, moderate, long-term impacts on native vegetation. The cumulative effects of these past, present, and reasonably foreseeable future actions would be different at different elevations. At the higher elevations, where the exotic plant infestations are the smallest and least numerous, the cumulative effects on native vegetation would be long term, beneficial, and moderate. At the low elevations, where the exotic plant infestations are the greatest, the cumulative effects of these past, present, and reasonably foreseeable future actions, including the no action alternative, would have short- and long-term, moderate, adverse impacts on the native vegetation.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to vegetation from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF PREFERRED ALTERNATIVE

**Impact Analysis.** Mechanical control methods can be very effective for new or very small infestations of exotic plants. These methods will also be the preferred choice near picnic areas, trailheads, and other high visitor use areas (See Chapter 2 and Chapter 3 for further information). Mechanical control will have a negligible, localized, adverse impact on native vegetation because occasionally an exotic plant is growing right up against a native plant and the native plant may be injured or killed when the exotic plant is removed. Hand-pulling and hand-cutting (rather than string-trimmers or chainsaws) will be used when exotic plants are growing right next to native plants. This would ensure that the native plants sustain the least impact possible.

Chemical control can be very effective for large infestations or for exotic plants with growth habits that make mechanical control methods ineffective. Herbicide use can injure or kill non-target plants. We will minimize the likelihood of this impact by spot-treating plants (using backpack sprayers or cut-stump treatments) and applying herbicides only under appropriate applications conditions (see mitigation section

in Chapter 2 for additional information). Chemical control may have short-term, negligible, localized, adverse impacts and long-term, moderate, beneficial impacts on native vegetation.

Cultural control would have a minor, long-term, beneficial impact on native vegetation by restoring previously infested areas with native vegetation. Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. Using biological control could have minor, short- or long-term, adverse impacts on native vegetation if the method is not selected and monitored very carefully. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods could negatively impact native vegetation if they are not applied carefully, impacts would be negligible, short term, and localized.

All of the methods described under the preferred alternative will have moderate, long-term, beneficial impacts if they are applied and monitored as prescribed in this plan. Native plant communities will be restored by removing exotic plant species. Removal of exotic plant species will also reduce the risk of wildfires at the lower elevations where native species are not adapted to fire. Overall, the preferred alternative will have short-term, minor, adverse, localized impacts to the native vegetation, and long-term, moderate, beneficial impacts to the native plant communities.

**Cumulative Impacts.** The cumulative impacts would be the same as the no action alternative.

**Conclusion.** The preferred alternative will have long-term, beneficial, moderate impacts to native vegetation. The cumulative effects of the past, present, and reasonably foreseeable future actions would have short-term, minor, adverse impacts to vegetation, but cumulatively with the preferred alternative would have long-term, beneficial, moderate impacts to native vegetation in Saguaro NP.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to vegetation from implementation of the preferred alternative at Saguaro National Park.

# WILDLIFE

### AFFECTED ENVIRONMENT

Wildlife resources at Saguaro National Park are diverse, reflecting the park's ecologically strategic location. The park's RMD lies at the interface of the Sonoran and Chihuahuan Deserts, and is part of the chain of scattered "sky-island" mountaintops in southeastern Arizona that connect the Rocky Mountains to the north with the Sierra Madre Mountains to the south. Faunal elements from both of these biomes are represented in the Rincon Mountains. In addition, the district ranges in elevation from 2,180 to 8,666 feet, and encompasses six structurally distinct biotic communities, from Sonoran desertscrub to mixed-conifer forest. The major drainages of the Rincon Mountains add riparian components to the park's faunal diversity, as well as provide wildlife movement corridors that link mountain ranges through the surrounding desert lands. Overall, the park supports a unique and diverse assemblage of thousands of invertebrates, and over 325 vertebrates, including approximately 70 mammals, 200 birds, 50 reptiles, and eight amphibians. The challenge in maintaining this biodiversity is underscored by the fact that since the turn of the last century, desert bighorn, Mexican gray wolves, jaguars, grizzly bears, and Gila topminnows have been extirpated from the RMD, while the TMD has lost desert bighorn and white-tailed deer.

RMD High Country. Southeastern Arizona is largely desertscrub and desert grassland. The tops of the scattered high mountain ranges (over 6,000 feet), including the Rincons, support forests that provide habitat for a suite of wildlife species that otherwise seem incongruous to the region. Examples include black bear, white-tailed deer, porcupine, tree squirrel, eastern cottontail, Mexican spotted owl, northern goshawk, and a host of neotropical migratory bird species. Due to their limited and disjunct habitats in the region, these species are of special management concern, particularly those federally listed as threatened or endangered, such as the Mexican spotted owl.

Riparian Areas/Corridors. Riparian areas are crucial in the desert southwest not only for the precious water resources they provide and protect, but also for providing dispersal "corridors" between mountain ranges for large terrestrial vertebrates. Species that rely on these areas, particularly at the lower elevations, include all of the park's aquatic species (e.g., Sonoran mud turtle, leopard frog), and animals that must drink water on a regular basis, such as most mammals and many birds. Riparian areas in the RMD also support many sensitive species, including the lowland leopard frog, canyon whiptail, many neotropical migratory bird species including the gray hawk and yellow-billed cuckoo, and the endangered cactus ferruginous pygmy-owl. These species are all of special management concern nationally, statewide, and/or locally, primarily due to dwindling numbers and habitats.

Water sources in the RMD that continue to contain water during drought periods (generally a few tinajas within larger drainages, but also some short reaches of Chimenea and Rincon Creeks) are crucial to wildlife, and in some cases are essential to the persistence of a species in an area. Loss of these resources can be caused by erosion from wildfires or invasion of exotic species. Water resources can also be lost due to exotic species (e.g., tamarisk). These losses could be disastrous for wildlife.

RMD Desertscrub. Wildlife in the lower elevations of the RMD is comprised of species typical of the Arizona Upland subdivision of the Sonoran Desert. Resident fauna includes such well-known and conspicuous species as mule deer, coyote, javelina, western diamondback rattlesnake, roadrunner, Gambel's quail, and many lizard and bird species, as well as rarer and more reclusive animals, such as the golden eagle, mountain lion, Sonoran desert tortoise, and Gila monster.

Tucson Mountain District. Overall, the fauna of the TMD is similar to the wildlife found in the lower elevations of the RMD. However, the TMD is lower in elevation, flatter, and sandier than the RMD, and thus contains some faunal elements associated with the Lower Colorado subdivision of the Sonoran Desert, such as kit fox, desert iguana, and sidewinder, which the RMD does not have.

Urbanization and development increasingly surround both districts. Insularization is a threat to the long-term viability of larger terrestrial vertebrate populations; TMD has already lost desert bighorn and white-tailed deer.

## METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to wildlife were derived from park staff's past observations of the effects on wildlife from visitor use, construction activities, prescribed fires, wildfires, and exotic plant removal. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | No native animal species would be affected or some individuals could be affected as a result of the alternative, but there would be no effect on native animal species populations. Impacts would be well within natural fluctuations. |

| | |
|---|---|
| Minor | The alternative would affect some individual animals and could also affect a limited portion of that species' population. Mitigation measures, if needed to offset adverse effects, would be simple and successful. |
| Moderate | The alternative would affect some individual animals and would also affect a sizeable segment of the species' population over a relatively large area within the park. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful. |
| Major | The alternative would have a considerable effect on individual animals and affect a sizeable segment of the species' population over a relatively large area in and out of the park. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed. |

The duration of wildlife impacts is considered short term if the recovery is less than one year and long term if the recovery is longer than one year.

### IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** There could be a short-term displacement of wildlife when working in the area, but this would be a negligible impact. Removing exotic plant species with hand tools may impact small vertebrate or invertebrate species that may be hiding in individual exotic plants. Based on removal efforts to date, this occurs infrequently so the impact to wildlife would be short term, negligible, and adverse. On the other hand, not removing all the exotic plant infestations of exotic species of concern could result in a long-term, moderate, adverse impact to wildlife if the exotic species significantly changed the habitat. For example, if buffelgrass was not controlled, then wildfires could occur in the Sonoran Upland where plant and animal species are not adapted to fire. This would result in a direct impact due to the conversion from native vegetation to a monoculture of buffelgrass. In addition, if fires occurred due to the buffelgrass, it could result in high mortality of species that are unable to escape the fires (e.g., desert tortoises). Fires in the Sonoran Upland could also impact lowland leopard frog populations by causing excess siltation of perennial pools. Overall, the impact of the no action alternative would be long term, moderate, and adverse.

**Cumulative Impacts.** Park construction projects would continue to have a negligible to minor, short-term, adverse impact on wildlife. Wildlife species would continue to be impacted by the rapid urbanization of the Tucson Basin, but the SDCP would offset some of those adverse impacts by conserving lands for biological and cultural resources. Allowing fires to burn naturally where and when it is appropriate would have both beneficial and adverse impacts on wildlife. In the long term, the overall impacts of returning fire to the high country would be moderate and beneficial. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short- and long-term, minor, adverse impacts at the lower elevations and long-term, minor to moderate, beneficial impacts on wildlife at the higher elevations.

**Conclusion.** The no action alternative will have long-term, moderate, adverse impacts on wildlife species, particularly at the lower elevations. When combined with the actions in and near the park, the cumulative effects overall will be short term, minor, and adverse and long term, minor, and adverse on the native wildlife species.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service

planning documents, there would be no impairment of park resources or values related to wildlife from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF PREFERRED ALTERNATIVE

**Impact Analysis.** Mechanical control methods may impact small vertebrate or invertebrate species that may be hiding in individual exotic plants. Based on previous removal efforts using hand tools, this occurs infrequently so the impact to wildlife would be short term, negligible, and adverse. There could be a temporary displacement of wildlife when working on exotic plant infestations, but this would be a negligible, localized, and temporary impact. It is unlikely that wildlife would permanently abandon an area from the noise or disturbance; mitigation measures would ensure breeding birds with sensitive species status would not be disturbed.

The herbicides proposed for use as a method of chemical control act upon plant-specific enzyme pathways; therefore the impact to wildlife under normal application conditions would be negligible. Long-term persistence of herbicides in the food chain, and subsequent toxic effects, is not expected to occur at Saguaro NP. This is due to the chemicals proposed for use, the low rates at which they would be applied, and the small quantities of herbicide to be used. The chemicals proposed for use do not contain organo-chlorines that can cause egg-shell thinning and other harmful effects to wildlife.

Cultural control would have a minor, long-term, beneficial impact on native wildlife species by restoring previously infested areas with native vegetation. Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. Using biological control could have minor, short-term, adverse impacts on native wildlife (e.g. through competition for food) if the method is not selected and monitored very carefully. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. Low-risk methods are not anticipated to affect wildlife species.

All of the methods described under the preferred alternative will have moderate, long-term, beneficial impacts when applied and monitored as prescribed in this plan. Native plant communities will be restored by removing exotic plant species. Removal of exotic plant species will also reduce the risk of wildfires at the lower elevations where native species are not adapted to fire. Overall, the preferred alternative will have short-term, negligible to minor, adverse, localized impacts to the native wildlife, and long-term, moderate, beneficial impacts to the native wildlife species.

**Cumulative Impacts.** Cumulative impacts would be the same as the no action alternative.

**Conclusion.** The preferred alternative will have short-term, negligible to minor, adverse, localized impacts to the native wildlife, and long-term, moderate, beneficial impacts to the native wildlife species. When combined with the actions occurring in and near the park, the impacts on the native wildlife species would be short term, minor, and adverse, and long term, moderate, and beneficial.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to wildlife from implementation of the preferred alternative at Saguaro National Park.

# SPECIAL-STATUS SPECIES (THREATENED, ENDANGERED, SPECIES OF CONCERN, AND DESIGNATED CRITICAL HABITAT)

## AFFECTED ENVIRONMENT

### Wildlife – Threatened, Endangered, and Species of Concern

There are four wildlife species listed by USFWS as threatened, endangered, or a candidate for listing that are known to occur, or have relatively recently occurred, in Saguaro NP: the lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*), Mexican spotted owl (*Strix occidentalis lucida*), and yellow-billed cuckoo (*Coccyzus americanus*). The RMD contains designated Critical Habitat for the Mexican spotted-owl, and the TMD contains proposed Critical Habitat for the cactus ferruginous pygmy-owl. Potential impacts to threatened and endangered species are fully analyzed in a Biological Assessment of the proposed action (see Appendix G of the Final EA). There are also 16 federal or state-listed "species of special concern" or "sensitive species," (Appendix F) that occur or have occurred in the Park: northern goshawk (*Accipiter gentilis*), northern gray hawk (*Asturina nitida maxima*), western burrowing owl (*Athene cunicularia hypugaea*), common black-hawk (*Buteogallus anthracinus*), northern buff-breasted flycatcher (*Empidonax fulvifrons pygmaeus*), American peregrine falcon (*Falco peregrinus anatum*), Mexican long-tongued bat (*Choeronycteris mexicana*), Townsend's big-eared bat (*Corynorhinus townsendii pallescens*), western red bat (*Lasiurus blossevillii*), California leaf-nosed bat (*Macrotus californicus*), cave myotis (*Myotis velifer*), pocketed free-tailed bat (*Nyctinomops femorosaccus*), yellow-nosed cotton rat (*Sigmodon ochrognathus*), desert tortoise (*Gopherus agassizii*), giant spotted whiptail (*Cnemidophorus burti stictogrammus*), and lowland leopard frog (*Rana yavapaiensis*).

Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)
The lesser long-nosed bat is a nectar-feeding bat that migrates between its wintering grounds in parts of Mexico and its breeding/summering grounds in northern Mexico, and in southern Arizona and New Mexico in the United States (USFWS 1995a). Lesser long-nosed bat migrations coincide with the availability of the nectar, pollen, and fruit of columnar cactus (e.g., cardon, organ pipe cactus, saguaros) and the nectar and pollen of blooming agaves. In Arizona, this species forms large maternity colonies that give birth in June. Maternity roosts are typically in caves or abandoned mines and are found in "lower elevations near concentrations of flowering columnar cacti" (USFWS 1995a). Beginning mid-July, bats appear in caves and mines in southeastern Arizona, forage on agave blooms, and leave the area in September and October. Most late-summer colonies are females and volant young, but small bachelor colonies exist also. The bat was listed by the USFWS as federally endangered, primarily due to loss of roosting habitat and vulnerability to disturbance of maternity colonies and other roosting sites (Shull 1988).

Bat surveys in Saguaro National Park confirmed a small (less than five individuals since 1991) colony of lesser long-nosed bats roosting in a cave in the RMD (Sidner 1991, Sidner & Davis 1994). We presume this species is foraging in the dense saguaro stands of the RMD early in the summer, and perhaps using agave flowers (*Agave palmeri*) found at higher elevations in this district (3,000-7,000 feet; Bowers and McLaughlin 1987) later in the year. Although surveys were conducted in 1991 and 2003 to locate lesser long-nosed bats, or evidence of them, in mines in the TMD, this species has never been documented in that district (Sidner 1991, Wolf and Dalton 2003).

Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)

The cactus ferruginous pygmy-owl (CFPO) is a small (about 6.75 inches long), long-tailed, earless owl federally listed as endangered due to a dramatic decline in its abundance and distribution in the U.S. in the last 50 years (Abbate et al. 1996). Loss of habitat is suspected as the major cause of its decreased numbers (USFWS 1993). The CFPO is the northernmost subspecies of the wide-ranging, but tropically based ferruginous pygmy-owl (Phillips et al. 1964). Although historic accounts associated this subspecies with riparian woodlands and mesquite bosques in Arizona (Phillips et al. 1964, USFWS 1993), recent sightings of CFPOs in the state have generally been in the paloverde-cacti-mixed scrub series of Sonoran desertscrub in the Arizona Upland subdivision (Abbate et al. 1996). Both districts of Saguaro National Park contain potential habitat for CFPO - virtually all of the TMD, and the RMD below 4,000 feet (some 40,000 acres total). However, only the Tucson Mountain District of Saguaro National Park currently contains proposed Critical Habitat for this species.

Since 1994, Saguaro NP staff, AGFD biologists, private contractors, and volunteers have surveyed for CFPO within and nearby the park. Surveys through 2000 (about 250 in the RMD and 250 in the TMD) have been about equally divided between inventory efforts and clearance surveys. A total of 350 surveys (half in each district) have been conducted by the park during annual surveys 2001-2004. All of these surveys followed protocols specified by AGFD and the USFWS at the time.

There was a probable detection of a CFPO in March, 1984 and a confirmed detection on October 12, 1995 in the RMD. There is an unverified report of a roadkill cactus ferruginous pygmy-owl in the TMD from January 2, 1988 (NPS files). The species has also been reported from King Canyon (Davis and Russell 1990), but it is unknown if the report was from within the park or in the adjacent Tucson Mountain Park (Pima County Parks and Recreation).

Mexican spotted owl (*Strix occidentalis lucida*)

The Mexican spotted owl is one of three spotted owl subspecies, and is listed as threatened by both the USFWS and the Arizona Game and Fish Department (USFWS - 58 FR 14248, AGFD 1988). Spotted owls are large (relative to other North American owls), dark-eyed owls that lack ear tufts, and are generally brown with heavy white to beige spotting. The Mexican subspecies is disjunctly distributed from southern Mexico northward into southern Utah and central Colorado (USFWS 1995b). Mexican spotted owls occupy a variety of habitat types ranging from dense mixed-conifer forests to steep-walled, rocky canyons (USFWS 1995b). In southern Arizona they typically occur in mixed-conifer, Madrean pine-oak and Arizona cypress forests, encinal oak woodlands, and riparian forests (USFWS 1995b). Nest sites are generally located in closed-canopy forests or steep-walled canyons. Occupied forest habitats generally contain mature old-growth stands and uneven-aged stands that are vertically complex with dense canopies (USFWS 1995b). Few published data exist concerning foraging habitat for Mexican spotted owls; however, it appears that foraging habitats generally have big logs, dense canopies, and large, densely distributed trees and snags (USFWS 1995b).

Mexican spotted owl surveys in Saguaro NP since 1992 have documented five territories within the RMD of the park (Berner and Mannan 1992, Bailey 1993, Kline 1994, Willey 1997, 1998, Knipps 1999, Jurgensen 2002, 2003). Four territories are on Mica Mountain and the fifth is on Rincon Peak. These territories are consistently occupied every year, though sometimes by only one bird or a non-breeding pair. Protected Activity Centers (PACs) have been established for each of these territories. In February 2001, the USFWS designated much of the RMD of Saguaro NP as Critical Habitat for the Mexican spotted owl (66 FR 8530).

Yellow-billed cuckoo (*Coccyzus americanus*)

The yellow-billed cuckoo was designated by USFWS as a candidate species for listing under the Endangered Species Act (66 FR 3 8611, July 25, 2001). It is a medium sized bird with a slender, long-tailed profile. It has a slightly down-curved bill, which is blue-black with yellow on the lower half of the bill. Plumage is grayish-brown above and white below, with rufous primary flight feathers. It is found in large blocks of riparian woodlands (cottonwood, willow, or tamarisk galleries) and feeds exclusively on insects (AESFO 2001).

In southeastern Arizona, the yellow-billed cuckoo is a summer resident in tall, dense, riparian growth, mostly in the San Pedro, Patagonia-Sonoita Creek, and Arivaca Creek drainages (Taylor 1995). In the RMD it is considered a transient and potential breeder; there was a recent sighting at Rincon Creek (Powell et al. 2002, 2003).

*Plants – Threatened, Endangered, and Species of Concern*
Saguaro NP has no plant species currently listed as federally threatened or endangered, nor any candidates for threatened or endangered status. There are a number of federal and state-listed "species of concern" or "sensitive species," which are designations for species in need of concentrated conservation actions, depending on the health of the population and the type and degree of threats (Appendix F). Sensitive plant species found in Saguaro NP are Pima Indian mallow (*Abutilon parishii*), Lemmon milkweed (*Asclepias lemmonii*), Tucson Mountain spiderling (*Boerhavia megaptera*), magenta-flower hedgehog-cactus (*Echinocereus fasciculatus*), Mexican broomspurge (*Euphorbia gracillima*), feather bush (*Lysiloma microphylla* var. *thornberi*), Thornber fishhook cactus (*Mammillaria thornberi*), weeping muhly (*Muhlenbergia xerophila*), Lemmon cloak fern (*Notholaena lemmonii*), Kelvin cholla (*Opuntia kelvinensis*), staghorn cholla (*Opuntia versicolor*), desert night-blooming cereus (*Peniocereus greggii* var. *transmontanus*), Chiricahua Mountain brookweed (*Samolus vagans*), nodding blue-eyed grass (*Sisyrinchium cernuum*), and Tumamoc globeberry (*Tumamoca macdougalii*).

## METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to special-status species were derived from USFWS Recovery Plans, available literature, and park staff's past observations of the effects on special-status species from visitor use, construction activities, prescribed fires, wildfires, and exotic plant removal. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | No special-status species would be affected or some individuals could be affected as a result of the alternative, but there would be no effect on special-status species' populations. Impacts would be well within natural fluctuations. |
| Minor | The alternative would affect some special-status individuals and would also affect a limited portion of that species' population. Mitigation measures, if needed to offset adverse effects, would be simple and successful. |
| Moderate | The alternative would affect some special-status individuals and would also affect a sizeable segment of the species' population over a relatively large area within the park. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful. |
| Major | The alternative would have a considerable effect on special-status individuals and affect a sizeable segment of the species' population over a relatively large area in and out of the park. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed. |

Special-status species' impacts are considered short term if the species recovers in less than one year and long term if it takes longer than one year for the species to recover.

### IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** Removing exotic plant species with hand tools may impact special-status plant species, but only if the exotic plant is growing and entangled with the species of concern. The use of mechanical control methods could temporarily disturb or displace special-status animal species that may be in those areas. This would cause a localized, short-term, negligible adverse impact to special-status wildlife species. On the other hand, not removing all the exotic plant infestations of exotic species of concern could result in a long-term, moderate, adverse impact to special-status species if the exotic species significantly changed the habitat. For example, if buffelgrass was not controlled, then wildfires could occur in the Sonoran Upland where plant and animal species are not adapted to fire. This would result in a direct impact due to the conversion from native vegetation to a monoculture of buffelgrass. If fires then occurred due to the buffelgrass, it could result in high mortality of species (or particular life stages of species) that are unable to escape the fires or it could directly impact the roosts of special-status species like the lesser long-nosed bat or the cactus ferruginous pygmy-owl. Overall, the impact of the no action alternative would be long term, moderate, and adverse.

**Cumulative Impacts.** Park construction projects would continue to have a negligible, short-term, adverse impact on special-status species. Special-status species would continue to be impacted by the rapid urbanization of the Tucson Basin, but the SDCP would offset much of those adverse impacts by conserving lands with high biological integrity and high resource value. Allowing fires to burn naturally where and when it is appropriate would have both beneficial and adverse impacts on wildlife. In the long term, the overall impacts of returning fire to the high country would be moderate and beneficial. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, negligible, adverse impacts and long-term, minor, beneficial impacts on special-status species.

**Conclusion.** The no action alternative would have long-term, moderate, adverse impacts on the special-status species at Saguaro NP. When combined with the actions in and near the park, the cumulative effects will be long term, minor, and adverse.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to special-status species from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF PREFERRED ALTERNATIVE

**Impact Analysis.** Mechanical control methods may have a localized impact on small vertebrate or invertebrate species that may be hiding in individual exotic plants. Based on previous removal efforts using hand tools, this occurs infrequently. If a special-status plant is growing adjacent to an exotic plant, care would be taken to remove only the exotic plant. It would be more harmful to the special-status species in the long term if we left the exotic plants in place compared to the potential short-term harm if we damaged a special-status plant while removing an exotic plant. There could be a temporary displacement or disturbance of special-status wildlife species during the mechanical control of exotic plant infestations, but this would be a negligible, localized, and temporary impact. Mitigation measures have been outlined in Chapter 2 that would reduce or eliminate any adverse impacts to special-status species.

The herbicides proposed for use as a method of chemical control act upon plant-specific enzyme pathways; therefore the impact to special-status wildlife species under normal application conditions

would be negligible. Long-term persistence of herbicides in the food chain, bioaccumulation, and subsequent toxic effects, is not expected to occur at Saguaro NP. This is due to the chemicals proposed for use, the low rates at which they would be applied, and the small quantities of herbicide to be used. The chemicals proposed for use do not contain organo-chlorines that can cause egg-shell thinning and other harmful effects to wildlife. If special-status plants were located in areas where herbicides were to be used, a buffer would be left around the special-status species and exotic plants within the buffer zone would be hand-pulled rather than treated with herbicides. This would eliminate the risk of overspray damaging special-status plants.

Cultural control would have a minor, long-term, beneficial impact on special-status species by restoring previously infested areas with native vegetation. Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. Using biological control could have minor, short-term, adverse impacts on special-status wildlife (e.g. through competition for food) if the method is not selected and monitored very carefully. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. Low-risk methods could impact special-status plant species if they are growing adjacent to the exotic plants. If special-status plants were found in an area to be treated, a buffer would be left around the special-status species and exotic plants within the buffer zone would be hand-pulled rather than treated with herbicides. This would eliminate the risk of damaging special-status plants.

All of the methods described under the preferred alternative will have moderate, long-term, beneficial impacts to special-status species and their habitats when applied and monitored as prescribed in this plan. Native plant communities will be restored by removing exotic plant species. Removal of exotic plant species will also reduce the risk of wildfires at the lower elevations where native plant and animal species are not adapted to fire. Overall, the preferred alternative will have short-term, negligible, adverse, localized impacts to special-status species, and long-term, moderate, beneficial impacts to special-status species.

**Cumulative Impacts.** Cumulative impacts would be the same as the no action alternative.

**Conclusion.** The preferred alternative will have short-term, negligible, adverse, localized impacts to special-status species, and long-term, moderate, beneficial impacts to special-status species. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, negligible, adverse impacts and long-term, minor, beneficial impacts on special-status species. The preferred alternative would beneficially contribute to long-term impacts on special-status species and their habitats.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to special-status species from implementation of the preferred alternative at Saguaro National Park.

# WATER QUALITY AND QUANTITY

### AFFECTED ENVIRONMENT

Watersheds in Saguaro National Park are generally small with first, second, and third order drainages (Mott 1997). In the TMD, these drainages are strictly ephemeral, flowing primarily in response to summer "monsoon" storm events that bring brief but substantial precipitation. Unlike the summer storms that

commonly lead to flash flooding, winter precipitation tends to be gentler and longer in duration; this rainfall better infiltrates the soil with minimal surface flow. The TMD receives about 11.8 inches of precipitation annually, fairly equally divided between winter and summer. No perennial water or wetlands are present in the district, although a few small natural intermittent seeps occur near King Canyon. Additionally, three windmills provide supplemental water for wildlife, drawing water from wells into man-made catchments. Two of these are maintained to mitigate the loss of wildlife access to water sources along Brawley Wash, which was isolated from the TMD by the Central Arizona Project canal. It is unclear the historic reason for the construction of the third windmill, but is thought to have been built for livestock or wildlife mitigation on the east side of the Tucson Mountains.

The RMD has much higher elevation watersheds than the TMD, reaching over 8,000 feet compared to the TMD, whose highest peak is 4,687 feet. This difference means that larger amounts of precipitation are collected at the RMD. Annual rainfall in the lower elevations averages 11 inches, like the TMD, but annual precipitation near Mica Mountain can exceed 30 inches, and the snow pack can be heavy in the winter months. In average years, snowmelt in winter and spring leads to the majority of the annual surface flow. Summer conditions are similar to the TMD, where surface flow occurs exclusively after large storm events. Streams are perennially interrupted, intermittent or ephemeral, but pools of water often remain year round. Several springs and seeps occur throughout the upper elevations.

### METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to water quality and quantity were derived from park staff's past observations of the effects on water quality and quantity from visitor use, construction activities, prescribed fires, wildfires, and exotic plant removal. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | There would be no observable or measurable impacts to water quantity or quality. Impacts would be well within natural fluctuations. |
| Minor | Impacts would be detectable and/or localized, but they would not be expected to be outside the natural range of variability. Mitigation measures, if needed to offset adverse effects, would be simple and successful. |
| Moderate | The impact to water quality or quantity would be readily apparent and result in a change over a relatively wide area. Mitigation measures would be necessary to offset adverse effects and likely be successful. |
| Major | The impact to water quality or quantity would be readily apparent and substantially change over a wide area. Mitigation measures to offset adverse effects would be necessary, extensive, and their success could not be guaranteed. |

### IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** Under the no action alternative, exotic plant species would primarily be controlled by mechanical (hand tool) methods. Locations with large infestations would receive more soil disturbance due to mechanical control when compared to small infestations. The localized soil disturbance from mechanical removal of exotic plants could reduce soil stability until plants have reestablished on the disturbed sites, which could result in reduced water quality in drainages after significant rain events. This

potential impact would be minimized by tamping the soil back into place after removal of the exotic plants. The exotic plant infestations would not be effectively controlled under this alternative because of the large amount of time it takes to mechanically remove populations; therefore locations that did not receive treatment could see changes in water availability/quantity when compared to areas containing native vegetation. This impact would be most evident in riparian communities. The no action alternative would result in minor, localized, short-and long-term, adverse impacts to water quality and quantity.

**Cumulative Impacts.** Park construction projects could have short-term localized impacts on water quality or quantity. The increase in urbanization near the park's boundary would continue to impact water quantity by continuing to lower the water table. The SDCP will protect high priority habitats from development which would as a result, protect water quality in those areas, but may not protect water quantity. Allowing fires in Saguaro NP to burn naturally where and when it is appropriate will have impacts on water quality or quantity depending on the intensity of the fire. As the natural fire interval is returned to the system, the intensity of fires should decrease, which would result in a decrease in the impact to water quality and quantity. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short- and long-term, minor, adverse impacts on water quality and quantity.

**Conclusion.** Impacts to water quality and quantity under this alternative would be minor, localized, short and long term, and adverse because exotic plant infestations would be controlled by mechanical means which could result in reduced water quality. In addition, exotic plant infestations would not be effectively managed, which would result in reduced water quantity. The cumulative effects of the past, present, and reasonably foreseeable future actions would have short- and long-term, minor, adverse impacts on water quality and quantity. The combined impacts of the no action alternative and the cumulative impacts would have short- and long-term, moderate, adverse impacts on water quality and quantity.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to water quality or quantity from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF PREFERRED ALTERNATIVE

**Impact Analysis.** Using an integrated approach to manage exotic plant infestations will allow the park to minimize the amount of adverse impact caused by managing exotic plant populations. The impacts on water quality and quantity will be much less for the preferred alternative when compared to the no action alternative because we will not rely completely on mechanical control methods.

Mechanical control can be very effective for new infestations of exotic plants and when plants are few in number. The localized soil disturbance from mechanical removal of exotic plants could reduce soil stability until plants have reestablished on the disturbed sites, which could result in reduced water quality in drainages after significant rain events. This impact would be minimized by tamping the soil back into place after removal of the exotic plants and by using this method only on small infestations. Mechanical control is expected to have short-term, negligible, localized, and adverse impacts on water quality or quantity.

Chemical control can be very effective for large infestations of exotic plants and for plants with growth habits that make mechanical control methods ineffective. If herbicides used for chemical control would be applied near water, it would only be herbicides labeled for such use and would be applied very carefully

to minimize overspray. With the implementation of the mitigation measures (Chapter 2), the use of chemical control would have negligible, short-term, localized adverse impacts on water quality and quantity.

Cultural control would have a minor, long-term, beneficial impact on water quality and quantity by returning native vegetation to currently infested areas. Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. Bringing in animals to graze exotic plants could have minor, short-term, adverse impacts on water quality or quantity if they used locally available water supplies. This could be mitigated by requiring water to be brought in for the animals rather than using existing water sources in the park. Insects would have no impacts on water quality or quantity. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods will not impact water quality or quantity if applied properly, but could have a negligible, short-term, localized, adverse impact on water quality and quantity.

In addition, by removing exotic plant species, native plant communities will be restored. This will have positive effects on soil nutrient availability and cycling, water availability, and soil erosion. Consequently, the preferred alternative will have negligible, short-term, adverse impacts and minor, long-term, beneficial impacts on the water quality and quantity.

**Cumulative Impacts.** The cumulative impacts would be the same as the no action alternative.

**Conclusion.** Adverse impacts to water quality and quantity would be less under the preferred alternative due to the ability to select the exotic plant control method that is best for each individual infestation and site. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short- and long-term, minor, adverse impacts on quality and quantity. Overall, the preferred alternative's contribution to the adverse impacts on water quality and quantity would be short term and negligible. On the other hand, in the long term, the preferred alternative would have minor, beneficial impacts on the water quality and quantity in Saguaro NP.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to water quality and quantity from implementation of the preferred alternative at Saguaro National Park.

# ARCHEOLOGICAL RESOURCES AND HISTORIC STRUCTURES

## AFFECTED ENVIRONMENT

### Archeological Resources

A combination of intensive and reconnaissance archeological surveys has provided us with a good understanding of the location of archeological sites in Saguaro NP. The prehistoric sites include camps, villages, agricultural sites, quarries, rock art sites, and rock shelters. These resources are generally confined to the lower elevations of the park (below 4500 feet elevation), which is also where the most invasive exotic plant species occur. The portion of the RMD that lies below 4,500 feet elevation is listed on the National Register of Historic Places as the Rincon Mountain Foothills Archeological District.

### Historic Resources

There are a number of historic structures and sites in Saguaro National Park. Manning Cabin, at 8,000 feet in the Rincon Mountains, is on the National Register of Historic Places. The Freeman Homestead and the Lime Kilns, also in the RMD, are on the State Register of Historic Places. The Athel tamarisk at the Freeman Homestead will not be treated/eradicated because it is one of the contributing features for the listing of this Historic Place. On the other hand, when the tree finally dies a natural death, the park is not required to replace it.

The distinctive stone masonry seen in the TMD picnic areas and along the roads in both park districts is the work of the Civilian Conservation Corps. Other historic resources include mining and ranching sites as well as historic trash deposits.

## METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to archeological and historic resources were derived from park staff's past observations of the effects on archeological and historic resources from exotic plant removal. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | Impact is at the lowest levels of detection – barely measurable with no perceptible consequences, either adverse or beneficial, to archeological resources or historic structures. |
| Minor | Adverse impact – disturbance of site(s) results in little, if any, loss of significance or integrity and the National Register eligibility of the site(s) is unaffected. For purposes of Section 106, the determination of effect would be *no adverse effect*.<br><br>Beneficial impact – maintenance and preservation of site(s). |
| Moderate | Adverse impact – disturbance of a site(s) that does not diminish the significance or integrity of the site(s) to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, the determination would be *adverse effect*.<br><br>Beneficial impact – stabilization of a site(s). |
| Major | Adverse impact – disturbance of a site(s) diminishes the significance and integrity of the site(s) to the extent that it is no longer eligible to be listed in the National Register.<br><br>Beneficial impact – active intervention to preserve a site(s). |

## IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** Relying on mechanical control methods to treat exotic plant infestations could have adverse impacts on archeological resources if they are unknown and uncovered during exotic plant removal. In addition, a limited number of infestations will be treated due to the labor intensiveness of mechanical removal and the size of infestations. Those areas not treated will could have adverse, moderate, long-term indirect impacts on archeological resources and historic structures due to the increased risk of fires in areas that do not normally have fires. A direct adverse impact would be in locations where exotic plant infestations are growing on top of archeological resources. All field crews will receive cultural site awareness training (see mitigation measures in Chapter 2 for more information), but using hand tools to dig up the infestations could still have minor impacts on the resources, particularly if unknown resources are found while removing the exotic plants. Some exotic plant infestations could

not be treated with mechanical control methods due to the type of archeological resources present; therefore those sites would be left untreated and at greater risk for fires. Overall, the no action alternative would have minor, adverse impacts on archeological resources and historic structures.

**Cumulative Impacts.** Park construction projects would continue to have an impact on archeological and historical resources. Typically these projects are either mitigated by completing data recovery before the project commences and having archeological monitors present during the project, or by modifying plans and designs to avoid impacts altogether. The population of the Tucson basin is increasing, leading to the construction of more homes near the park boundary and potentially affecting cultural resources outside the park that could contribute to the gradual deterioration of historic fabric, terrain, or setting. This impact may be offset by the conservation of lands associated with the SDCP, which includes most of the land bordering both districts of the park. Allowing fires in Saguaro NP to burn naturally where and when it is appropriate will have negligible impacts on archeological resources and historic structures because there are very few cultural resources in the park where wildfires will be allowed to burn, and the known sites will be protected in the event of a fire. The cumulative effects of these past, present, and reasonably foreseeable future actions would have minor adverse impacts on archeological resources and historic structures.

**Conclusion.** The no action alternative would have minor to moderate, adverse impacts on archeological resources and historic structures. The cumulative effects also would contribute minor, adverse impacts on archeological resources and historic structures. The combined impacts of the no action alternative and the cumulative impacts would have moderate, adverse impacts on archeological resources and historic structures.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to archeological and historic resources from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF PREFERRED ALTERNATIVE

**Impact Analysis.** Using an integrated approach to manage exotic plant infestations will allow the park to minimize the amount of adverse impact caused by managing exotic plant populations. The impacts on archeological resources and historic structures will be much less for the preferred alternative when compared to the no action alternative because we will not rely completely on mechanical control methods.

Under the preferred alternative, mechanical control methods, like digging up plants or using string trimmers to cut back plants, would be used on very small exotic plant infestations and would not be used at known archeological sites or on plants growing within archeological structures. If presently unidentified archeological resources are discovered during mechanical treatment, it could have a minor, adverse impact on those resources.

Chemical control can be very effective for large infestations of exotic plants and for plants with growth habits that make mechanical control methods ineffective. It can also be an effective control method on known archeological sites where the use of hand tools may be restricted or prohibited. Using herbicides to control exotic plants would have a negligible impact on archeological resources and historic structures.

Cultural control would have a negligible adverse impact on archeological resources through the ground-disturbing activities associated with native plant revegetation. Any revegetation activity would require

cultural clearance to reduce the likelihood of adverse impacts on archeological resources. Historic structures would not be impacted by cultural control methods because they would not be applied to the structures.

Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. Grazing animals would not be used where archeological resources or historic structures are located, therefore they would have no impact on those resources. Insects would have no impacts on archeological resources or historic structures. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods will not impact archeological resources if applied properly near archeological resources and would not be applied to historic structures.

In addition, by removing exotic plant species, native plant communities will be restored. This will reduce the risk of wildfire in the areas of the park that have the greatest concentration of archeological resources and historic structures. Overall, the preferred alternative will have long-term, minor beneficial impacts on archeological resources and historic structures.

**Cumulative Impacts.** Cumulative impacts would be the same as the no action alternative.

**Conclusion.** The preferred alternative will have minor beneficial impacts on archeological resources and historic structures. The cumulative effects of these past, present, and reasonably foreseeable future actions would have minor, adverse impacts on archeological resources and historic structures. The preferred alternative will be a beneficial contribution to archeological resources and historic structures.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to archeological resources and historic structures from implementation of the preferred alternative at Saguaro National Park.

# WILDERNESS

### AFFECTED ENVIRONMENT

Most of the land base in Saguaro National Park has been formally designated as wilderness in accordance with the provisions of the Wilderness Act. There are 13,470 acres of wilderness in the TMD and 57,930 acres in the RMD (Figure 1). The impacts of the proposed actions on wilderness areas in Saguaro NP were analyzed by assessing their effect on both the wilderness user and the wilderness setting.

### METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to wilderness were derived from park staff's knowledge of the wilderness and assessing the effect of the alternatives on both the wilderness user and the wilderness setting. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | The impact from the proposed action would be so small that it would not be of any |

| | |
|---|---|
| | measurable or perceptible consequence. |
| Minor | The impact from the proposed action would be slight, but would be small and localized. |
| Moderate | The impact would be readily apparent and would be measurable, but would be localized. |
| Major | The impact is substantial, highly noticeable, and measurable. |

## IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** The use of hand tools to remove non-native plant populations would be within wilderness guidelines and would have no impact on the wilderness users. Controlling exotic plant populations would have a beneficial impact on the wilderness resources in the areas that they were controlled. Not all exotic plant infestations would be controlled under the no action alternative, therefore the impact to the wilderness setting in the long term will be adverse and moderate due to the degradation caused by the exotic plant species (i.e. through loss of native vegetation and associated impacts to native wildlife, fires in the lower elevations where fire does not normally occur). If field crew sizes were large, it could have an adverse impact on a visitor's wilderness experience, but this impact would be short term, localized, and minor. Overall, the no action alternative would have a short-term, localized, minor, adverse impact on the wilderness user, but a long-term, moderate, adverse impact to the wilderness setting, particularly at the lower elevations where the majority of the exotic species are found.

**Cumulative Impacts.** Park construction projects, particularly certain types of trail work, may have a localized, short-term, minor, adverse impact on the wilderness user, but would have a long-term, minor, beneficial impact on the wilderness setting through maintenance of the trails. The increasing population in the Tucson basin will have a minor adverse impact on the wilderness user and setting because as the population increases, more people are likely to use the wilderness for recreation. The implementation of the SDCP would have a long-term, minor, beneficial impact on the wilderness user and setting through the conservation of high priority biological and cultural resources. The return of natural and prescribed fire to the high country at Saguaro NP would have a short-term, minor, adverse impact on wilderness users that could not access the areas as they burn, but would have a long-term, moderate, beneficial impact on the wilderness setting and consequently on the wilderness users experience because of the improved health of the wilderness at the higher elevations. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, minor, adverse impacts on the wilderness user and setting, and long-term, moderate, beneficial impacts on the wilderness user and setting.

**Conclusion.** The no action alternative would have a short-term, localized, minor, adverse impact on the wilderness user, but a long-term, moderate, adverse impact to the wilderness setting, particularly at the lower elevations. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, minor, adverse impacts on the wilderness user and setting, and long-term, moderate, beneficial impacts on the wilderness user and setting at the higher elevations. The no action alternative would contribute to the overall adverse impacts to the wilderness user and setting at the lower elevations.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service

planning documents, there would be no impairment of park resources or values related to wilderness from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF PREFERRED ALTERNATIVE

**Impact Analysis.** Using an integrated approach to manage exotic plant infestations will allow the park to minimize the amount of adverse impact caused by managing exotic plant populations in wilderness.

Under the preferred alternative, mechanical control methods involving hand tools would be used on very small exotic plant infestations or in locations where conditions warrant the use of hand tools (like next to or in a water source if the exotic plant species can be controlled with mechanical control methods). String trimmers will be used on large populations of two perennial grass species (buffelgrass and fountain grass) in particular. These two species typically have a large amount of dead material that makes chemical treatment alone much less effective (Esque personal communication). The string trimmers would only need to be used on the first treatment of a population, subsequent treatments could be chemical or hand tool alone (depending on the size of the re-infestation). String trimmers will have a short-term adverse impact on the wilderness user, but it will be localized and of a very short duration. The impact of the string trimmers would be much less than the amount of time and disturbance required to mechanically remove some of the larger infestations of these two grasses. In addition, many of the large infestations are in areas that are not heavily used and are off-trail; visitors' access to off-trail areas is the park is restricted at the RMD below 4,500 feet (NPS 2001a). Effective treatment and eventual eradication of the exotic plant infestations will have a long-term, moderate, beneficial impact on the wilderness setting and wilderness user.

Chemical control can be very effective for large infestations of exotic plants and for plants with growth habits that make mechanical control methods ineffective. All of the herbicides proposed for use are low-risk herbicides that do not persist for long periods in the environment. The re-entry time period for all of herbicides selected is when the herbicide has dried (see Chapter 2 for mitigation measures and Appendix C for Safety Plan). In addition, at the RMD off-trail travel is prohibited below 4,500 feet, which is the elevation range that the majority of the treatments will be occurring. Therefore, the adverse impact of chemical control on the wilderness user will be negligible. The use of chemical control as part of an integrated management program will have a long-term, moderate, beneficial impact to the wilderness user and setting.

Cultural control would have a short-term, negligible, adverse impact on the wilderness user through the ground-disturbing activities associated with native plant revegetation, but it would be completed with hand tools which are an acceptable tool in the wilderness. The adverse impact would come from the perceived impact to a wilderness user's solitude. Cultural control would have a long-term, minor, beneficial impact to the wilderness setting and user through restoration of native species.

Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. Grazing animals would be carefully monitored and tended which could have a short-term, localized, minor adverse impact on the wilderness user. Insects would have no impacts on the wilderness user. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. If hot water/steam were used in the wilderness, it would have a short-term, minor, adverse impact on the wilderness user because of the equipment that would be necessary to produce the hot water or steam. This would only be used if it was determined that the method would be the most effective method for that infestation. Typically, another method would be chosen to avoid impacts to the wilderness user. The biological and low-risk methods would have a long-term, minor, beneficial impact on the wilderness setting.

In addition, by removing exotic plant species through an integrated management program, native plant communities will be restored. This will reduce the risk of wildfire in the areas of the park that are not adapted to fire and will improve habitat for native wildlife species. Consequently, the preferred alternative will have short-term, negligible to minor adverse impacts on the wilderness user, but long-term, moderate, beneficial impacts on the wilderness user and setting.

**Cumulative Impacts.** Cumulative impacts would be the same as the no action alternative.

**Conclusion.** Overall, the preferred alternative would have short-term, minor adverse impacts on the wilderness user, but have long-term, moderate, beneficial impacts on the wilderness setting. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, minor, adverse impacts on the wilderness user and setting, and long-term, moderate, beneficial impacts on the wilderness user and setting. The preferred alternative would be a long-term, beneficial contribution to the wilderness user and setting.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of park resources or values related to wilderness from implementation of the preferred alternative at Saguaro National Park.

# HUMAN HEALTH AND SAFETY

### AFFECTED ENVIRONMENT

Human health and safety may be directly influenced when people use the park and indirectly influenced by activities in the park that have some affect on humans living near the park. An example of a direct influence on human health would be an employee inadvertently breathing in a concentrated herbicide and becoming sick. An example of a direct influence on human safety would be getting bitten by a rattlesnake while hiking. An example of an indirect influence would be having an asthma attack at a home adjacent to the park, as a result of breathing dust from a large mechanical exotic plant removal project just inside the park boundary. Human use of the park is associated with recreation (hiking, backpacking, horseback riding, etc.) and management and research activities by park staff and cooperators.

### METHODOLOGY AND INTENSITY THRESHOLDS

Analyses of the potential intensity of impacts to human health and safety were derived from park staff's past observations of the effects on human health and safety from visitor use, prescribed fires, wildfires, and exotic plant removal efforts, from available literature, and from herbicide labels and material safety data sheets. The thresholds of change for the intensity of an impact are defined as follows:

| Impact Intensity | Intensity Definition |
|---|---|
| Negligible | The impact would be so small that it would not be of any measurable or perceptible consequence, and/or will affect few visitors or staff. |
| Minor | The impact is slight but would be small and localized and of little consequence, and/or will affect some visitors or staff. |

| | |
|---|---|
| Moderate | The impact is readily apparent, would be measurable and consequential, but more localized, and/or will affect many visitors or staff. |
| Major | The impact is severely adverse. The change would be measurable and possibly permanent, and /or will affect the majority of visitors or staff. |

The duration of impacts to human health and safety are considered short term if they will last only during the proposed treatment period (i.e. treatment of a particular site at a particular point in time) and long-term if they last longer than the treatment period.

### IMPACTS OF NO ACTION ALTERNATIVE

**Impact Analysis.** Under the no action alternative, exotic plant infestations would be primarily controlled by hand tools and to a lesser extent by revegetation of disturbed areas. Possible effects include cuts, burns, allergies, and skin irritation to individuals performing the work. Due to the uneven terrain in the park, minor injuries or falls may result. The use of personal protective equipment (PPE) such as gloves, long sleeves and boots should minimize this risk. These methods of control could have direct, short-term, negligible, adverse impacts to the individuals performing the work. The exotic plant infestations will not be effectively controlled under this alternative. This could have an indirect, negative impact on human health and safety, particularly if wildfires began to occur in the lower elevations where they currently do not occur. The fuel loads created by buffelgrass (Haines et al. *In Prep*) have the potential to cause very hot, fast fires which could have an indirect, long-term, minor to moderate (depending on the size and intensity of fire), adverse impact on human health and safety. Overall, the no action alternative would have a direct, short-term, negligible, adverse impact and an indirect, long-term, minor to moderate, adverse impact on human health and safety.

**Cumulative Impacts.** Park construction projects would have safety plans associated with them and would continue to have a short-term, negligible, adverse impact on human health and safety. The continued increase in population in the Tucson basin would continue to have minor to moderate impacts on human health and safety due to the increased numbers of people seeking places for recreation. This impact may be offset with the implementation of the SDCP and the resultant conservation of lands surrounding Saguaro NP which could spread out the users over a larger area. The return of natural fires when and where appropriate may have short-term, minor to moderate, adverse impacts on human health and safety during the fires, but would have long-term, moderate, beneficial impacts on human health and safety due to the return to natural fuel loads and the resultant decrease in fire intensity. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, negligible, adverse impacts on human health and safety and long-term, negligible to minor, adverse impacts on human health and safety.

**Conclusion.** The no action alternative would have a direct, short-term, negligible, adverse impact and an indirect, long-term, minor to moderate, adverse impact on human health and safety. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, negligible, adverse impacts on human health and safety and long-term, negligible to minor, adverse impacts to human health and safety. Overall, the no action alternative would contribute to the long-term adverse impacts on human health and safety.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service

planning documents, there would be no impairment of park resources or values related to human health and safety from implementation of the no-action alternative at Saguaro National Park.

### IMPACTS OF PREFERRED ALTERNATIVE

**Impact Analysis.** Using an integrated approach to manage exotic plant infestations will allow the park to minimize the amount of adverse impact caused by managing exotic plant populations. Mitigation measures and a safety plan have been included in this document (Chapter 2 and Appendix C). These are designed to minimize the impacts of the preferred alternative on both the environment and humans and strict adherence to this document will be required by all employees.

Under the preferred alternative, mechanical control methods using hand tools, string trimmers, or chainsaws have risks related to potential injury of field personnel conducting the work. Possible effects include cuts, burns, allergies, and skin irritation to individuals performing the work. Due to the uneven terrain in the park, minor injuries or falls may result. The use of personal protective equipment (PPE) such as gloves, long sleeves and boots should minimize this risk. All employees will use all PPE required for the work they are doing, as outlined in the job hazard analysis for the task. Job hazard analyses have been completed for all major work tasks and are maintained on the park's computer network. Mechanical control methods would have a negligible adverse impact on employee health and safety and no impact to public health and safety.

Chemical control can be very effective for large infestations of exotic plants and for plants with growth habits that make mechanical control methods ineffective. All of the herbicides proposed for use are low-risk herbicides that do not persist for long periods in the environment. No restricted use pesticides have been included in this plan. The US Forest Service has completed Risk Assessments for the six herbicides and the marker dyes proposed for use in this plan (SERA 1995, 1997a, 1997b, 1998, 1999, 2001, 2003a, 2003b).

The USFS Risk Assessments quantified general systemic and reproductive human health risks for a given herbicide by dividing the dose found to produce no ill effects in laboratory animal studies by the exposure a person might get from applying herbicides or from being near an application site. Human cancer risk was calculated for those herbicides that caused tumor growth in laboratory animal studies by multiplying a person's estimated lifetime dose of the herbicide by a cancer probability value (cancer potency) calculated from the animal tumor data. The risk assessment included a qualitative analysis of the risk of heritable mutation and synergistic effects. Those risks, summarized in Appendix D, are based on conservative, worst-case assumptions, including comparing short-term exposure to long-term safety levels. There can be an indirect effect on human health from herbicide use through improper application, mixing, or contamination of a water source. This indirect effect should be effectively mitigated through training, supervision, and careful adherence to safety protocols (Appendix C).

Risks for visitors to contact herbicides should be negligible. High visitation areas (like picnic areas and trailheads) will be treated by a non-chemical method first. If non-chemical control methods fail, then chemical control would be used. If chemical control were to be used in a high visitation area, it would be signed prior to and after treatment (beyond the re-entry period, see Chapter 3), a notice would be posted at the park's visitor center and on the park's website, and the area would be closed to public access during the treatment until it was safe to re-enter. In addition, the site would be treated when the least number of visitors would be impacted by the closure (off-season or off-hours). This would be an inconvenience rather than a risk to the public's health or safety. The use of chemical treatment methods in high visitation areas would have a short-term, negligible, adverse impact to visitor's health and safety.

Visitors will not typically encounter areas that have been treated with herbicides due to use restrictions or difficulty in accessing sites. Employees treating sites will remain in the area until it is safe for re-entry onto a site, so that any visitors that may come across a site will not enter it during the restricted entry period when they would be most likely to be exposed to herbicides. The re-entry time period for all of the herbicides selected is when the herbicide spray has dried (see Chapter 2 for mitigation measures and Appendix C for Safety Plan). In addition, at the RMD off-trail travel is prohibited below 4,500 feet, which is the elevation range that the majority of the treatments will be occurring. The overall impact of chemical control on the health and safety of visitors will be short term, adverse, and negligible.

Workers applying herbicides may be exposed to chemicals via dermal or respiratory routes (e.g. contact with vegetation at a recently treated site or breathing herbicide spray particles or vapors). Proper use of PPE can substantially reduce dermal exposure. Inhalation of herbicides is reduced by using protective breathing devices and applying herbicides only under the proper conditions (no wind). The strict adherence to the safety plan (Appendix C) and the mitigation measures (Chapter 2) outlined in this document will reduce the potential impacts to employees applying herbicides. The impact to employee health and safety would be short term, negligible, and adverse.

Cultural control would have a short-term, negligible, adverse impact on employee health and safety due to potential injuries associated with native plant revegetation. Possible effects include cuts, burns, allergies, and skin irritation to individuals performing the work. Due to the uneven terrain in the park, minor injuries or falls may result. The use of personal protective equipment (PPE) such as gloves, long sleeves and boots should minimize this risk. All employees will use all PPE required for the work they are doing, as outlined in the job hazard analysis for the task. Job hazard analyses have been completed for all major work tasks and are maintained on the park's computer network.

Biological control is not likely to be used, but could include introducing insects or herbivory to reduce exotic plant infestations. This method would have no impact on human health or safety. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. If hot water/steam were used, the employees applying the hot water/steam could receive burns if they did not follow protocols and wear the appropriate PPE, which should not occur. This method would have a short-term, negligible, adverse impact on human health and safety.

In addition, by removing exotic plant species through an integrated management program, native plant communities will be restored. This will reduce the risk of wildfire in the areas of the park that are not adapted to fire which will eliminate fire-related health effects. Overall, the preferred alternative will have short-term, negligible, adverse impacts on human health and safety.

**Cumulative Impacts.** Cumulative impacts would be the same as the no action alternative.

**Conclusion.** The preferred alternative would have short-term, negligible, adverse impacts on human health and safety. The cumulative effects of these past, present, and reasonably foreseeable future actions would have short-term, negligible, adverse impacts on human health and safety and long-term, minor, adverse impacts to human health and safety. The preferred alternative will not contribute significantly to the cumulative impacts on human health and safety.

**Impairment.** Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service

planning documents, there would be no impairment of park resources or values related to human health and safety from implementation of the preferred alternative at Saguaro National Park.

# CHAPTER 5 - CONSULTATION AND COORDINATION

## AGENCIES/TRIBES/ORGANIZATIONS/INDIVIDUALS CONTACTED

Agencies and organizations contacted for information; or that assisted in identifying important issues, developing alternatives, or analyzing impacts; or that will review and comment upon the environmental assessment and the programmatic agreement include:

Arizona State Historic Preservation Officer (SHPO)
U.S. Department of Interior – Fish and Wildlife Service
Arizona Game and Fish Department
U.S. Army Corps of Engineers
Affiliated American Indian Tribes
- Ak Chin Indian Community
- Fort McDowell Yavapai Nation
- Gila River Indian Community Council
- Hopi Tribe
- Pascua Yaqui Tribe
- Salt River Pima-Maricopa Indian Community
- Tohono O'Odham Nation
- Zuni Pueblo

A Programmatic Agreement between the NPS and the Arizona SHPO is currently in preparation. If it is determined that the Programmatic Agreement is not appropriate, then an Assessment of Effect will be completed.

The Biological Assessment/No Effect Statement was sent to the US Fish and Wildlife Service on 11/12/2004.

## PREPARERS

Danielle Foster, Restoration Ecologist, Saguaro National Park, Restoration Program Manager, primary preparer
Sandy Wolf, Wildlife Biologist, Saguaro National Park, assisted with preparation of wildlife and T&E sections and editing document
Matt Daniels, GIS Specialist, Saguaro National Park, prepared maps
James MacAdam, contract botanist, assisted with development of tables and appendices

## CONSULTANTS

**Saguaro National Park**
Sarah Craighead, Superintendent
Meg Weesner, Chief of Science and Resources Management
Natasha Kline, Wildlife Biologist
Don Swann, Wildlife Biologist
Mark Holden, Biologist

Bob Love, Chief of Ranger Services
Chuck Scott, Fire Management Officer
Susan Early, Administrative Officer
Jay Grass, Safety Officer
Barney Riley, Facility Manager

**Grand Canyon National Park**
Lori Makarick, Vegetation Program Manager
Sara White, Chief Compliance Officer

**US Forest Service - Coronado National Forest**
Rick Gerhart, Range NEPA Team Leader

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| **EA** | Environmental Assessment |
| **EPA** | Environmental Protection Agency |
| **ESA** | Endangered Species Act |
| **IPM** | Integrated Pest Management |
| **JHA** | Job Hazard Analysis |
| **MSDS** | Material Safety Data Sheet |
| **NEPA** | National Environmental Policy Act |
| **NP** | National Park |
| **NPS** | National Park Service |
| **PPE** | Personal Protective Equipment |
| **RMD** | Rincon Mountain District |
| **SDCP** | Sonoran Desert Conservation Plan |
| **SHPO** | Arizona State Historic Preservation Officer |
| **TMD** | Tucson Mountain District |
| **US** | United States |
| **USFS** | U.S. Forest Service |
| **USFWS** | U.S. Fish and Wildlife Service |
| **USGS** | U.S. Geological Survey |

# APPENDIX A

## PUBLIC SCOPING PRESS RELEASE AND LETTER

**National Park Service**
**U.S. Department of the Interior**

Saguaro National Park

3693 South Old Spanish Trail
Tucson, AZ 85730

520-733-5100 phone
520-733-5183 fax

# **Saguaro National Park** News Release

*For Immediate Release*
April 9, 2004
Contact: Danielle Foster, (520) 733-5187

## Saguaro National Park to Develop Exotic Plant Management Plan

Superintendent Sarah Craighead announced that Saguaro National Park is developing an Exotic Plant Management Plan with the associated compliance documentation, and is seeking public input on issues and concerns. Controlling exotic plant infestations is one of the most serious challenges facing the park. Currently, invasive exotic plants are found on an estimated 600 acres of the park's 91,000 acres. Recent models indicate that the amount of invaded land could increase to more than 12,000 acres if left uncontrolled. The development of a comprehensive plan will allow the park to evaluate the invasiveness of different exotic plant species and select appropriate control methods for the most invasive and controllable species.

The Exotic Plant Management Plan would outline a proactive, integrated approach to manage exotic plant infestations, including mechanical, cultural, chemical, and biological control techniques. Mechanical control includes removing plants using hand tools (picks, shovels) or gas-powered tools (chainsaws, string-trimmers). Cultural control includes reducing disturbance, planting or encouraging native vegetation, and education of visitors, staff, and the public about exotic plants and ways to reduce the spread of invasive plants. Chemical control includes using herbicides, and biological control involves using insects, mammals, or pathogens to stress exotic plants. Treatments for invasive exotic

plant populations would utilize an adaptive approach determined by location, population size, and other factors.

The Exotic Plant Management Plan and Environmental Assessment will be drafted and released for public comment in summer 2004. The public is invited to identify issues and concerns that they would like to see addressed in the plan and send comments to Superintendent Craighead by email to SAGU_Planning@nps.gov, or write her at Saguaro National Park, 3693 South Old Spanish Trail, Tucson, AZ 85730-5601. Comments during the public scoping period will be accepted through May 9, 2004.

Please be aware that names and addresses of respondents may be released if requested under the Freedom of Information Act. Our practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Respondents may request that we withhold their home addresses from the record, which we will honor to the extent allowable by law. There also may be circumstances in which we would withhold from the record a respondent's identity, as allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. We will make all submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

04-10

# United States Department of the Interior

NATIONAL PARK SERVICE
**Saguaro National Park**
**3693 S. Old Spanish Trail**
**Tucson, Arizona 85730**

IN REPLY REFER TO:
H4217

April 9, 2004

Reference: Saguaro National Park – Development of an Exotic Plant Management Plan
Subject: Compliance with Section 106 of the National Historic Preservation Act and National Environmental Policy Act (NEPA)

The National Park Service is developing an Exotic Plant Management Plan. Controlling exotic plant infestations is one of the most serious challenges for the park. Currently, invasive exotic plants are found on an estimated 600 acres of the park's 91,000 acres. Recent models indicate that the amount of invaded land could increase to more than 12,000 acres if left uncontrolled. The development of a comprehensive plan will allow the park to evaluate the invasiveness of different exotic plant species and select appropriate control methods for the most invasive and controllable species.

The Exotic Plant Management Plan would outline a proactive, integrated approach to manage exotic plant infestations, including mechanical, cultural, chemical, and biological control techniques. Mechanical control includes removing plants using hand tools (picks, shovels) or gas-powered tools (chainsaws, string-trimmers). Cultural control includes reducing disturbance, planting or encouraging native vegetation, and education of visitors, staff, and public about exotic plants and ways to reduce the spread of invasive plants. Chemical control includes using herbicides, and biological control involves using insects, mammals, or pathogens to stress exotic plants.

In accordance with NEPA and 36 CFR 800 requirements, we are eliciting your comments and concerns regarding the proposed plan. If you would like to express your concerns, have questions, or need additional information, please contact me by writing to the above address, through email at SAGU_Planning@nps.gov, or by telephone at (520) 733-5100. We would appreciate receiving your comments no later than May 9, 2004. The Exotic Plant Management Plan and Environmental Assessment will be prepared and posted to the park's website in summer 2004. If you are interested in receiving notice of the document's availability, please contact us.

Please be aware that names and addresses of respondents may be released if requested under the Freedom of Information Act. Our practice is to make comments, including names and home

addresses of respondents, available for public review during regular business hours. Respondents may request that we withhold their home addresses from the record, which we will honor to the extent allowable by law. There also may be circumstances in which we would withhold from the record a respondent's identity, as allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. We will make all submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

Sincerely,

Sarah Craighead
Superintendent

# APPENDIX B

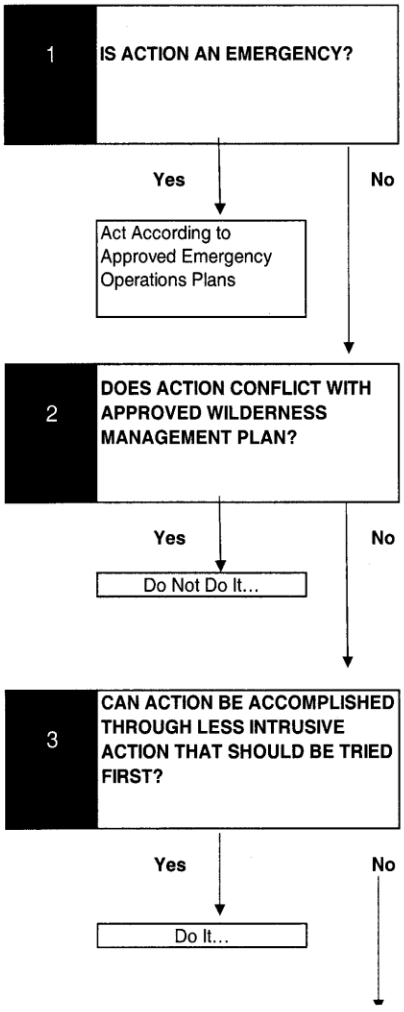
# WILDERNESS MINIMUM REQUIREMENT ANALYSIS

**Process for Determining Minimum Requirement**
Saguaro National Park

PROPOSED ACTION: Saguaro National Park would use a proactive, integrated approach to manage exotic plant infestations, including mechanical, cultural, chemical, low risk, and biological control techniques. The proposed action will be completed in both districts of the park, including wilderness and other specially designated areas. The Exotic Plant Management Plan would have a sunset date of 8 years.

Lead Person: Danielle Foster

**PART A: Minimum Requirement** *(should the action be done in wilderness?)*




Answer: ☐ Yes ☑ No
Explain:
The Exotic Plant Management Plan is the planning document that will guide exotic plant eradication and control efforts over the next 8 years. It is not an emergency.

Answer: ☐ Yes ☑ No
Explain:
Eradication or control of exotic species will maintain and improve habitat for T&E species, maintain healthy populations of other plant and animal species, and ensure the integrity of riparian areas (all 3 are listed in the Wilderness Mgmt Plan).

Answer: ☐ Yes ☑ No
Explain:
In certain cases, eradication will be achieved with the least impact to the resources if we use string-trimmers (weed-whackers) to remove dead vegetation before following up (3-4 weeks later) with an herbicide application.

Page 1 of 4

| | |
|---|---|
| 4 | **CAN ACTION BE ACCOMPLISHED OUTSIDE OF WILDERNESS AND STILL ACHIEVE ITS OBJECTIVE?** |

**Yes** → Do It There...

**No**

Answer: ☐ Yes ☑ No

Explain:
No, you have to treat the exotic plants where they are found, and some of them are found in the wilderness.

| | |
|---|---|
| 5 | **DESCRIBE IN DETAIL, ALTERNATE WAYS TO ACCOMPLISH THE PROPOSED ACTION?** |

→ List below...

Minimum Questions to Answer for each Alternative:

A. What is proposed?
B. When will action take place?
C. What designs and standards will apply?
D. What methods/techniques will be used?
E. How long will it take to complete?
F. What mitigation will take place to minimize action impacts?

**No Action: No mechanized transport or motorized equipment is proposed for continuing exotic plant control through use of hand tools, so this alternative is not examined further.**

**Preferred Alternative: Proposed: the park would use an integrated, proactive approach to control non-native species by selecting the most effective treatment for that species and location (i.e. adaptive management). String-trimmers would be used in certain situations to remove standing dead material 3-4 weeks prior to herbicide application. No other mechanized equipment is being proposed for use in the wilderness. When: String-trimmers would be used for a brief period of time in the winter (Nov. or Dec.) and then again briefly in the summer (June or July). They would only be used on large (0.10 acre or larger) patches of buffelgrass and fountaingrass. Standards/Mitigations: PPE would be used. As described in mitigations section of the plan, each site would be thoroughly checked for wildlife prior to treatment. Any wildlife observed would be monitored while other staff complete treatment to ensure wildlife is not impacted. Care would be taken to avoid damaging non-target vegetation. In cases where exotic plants are growing adjacent to native plants, hand pruners would be used instead of string-trimmers. Timeframe: The string trimmers will only need to be used on the first treatment of a large patch, to return the cover to pre-exotic plant infestation levels. Follow-up treatments can be completed without mechanized equipment. It is anticipated that the large patches can receive their initial treatment within the first 3 years of this plan, hopefully sooner.**

| | |
|---|---|
| 6 | **EVALUATE WHICH ALTERNATIVE WOULD HAVE THE LEAST IMPACT ON WILDERNESS RESOURCES, CHARACTER, AND VISITOR EXPERIENCE** |

Minimum Criteria used to Evaluate each Alternative?

1. Biophysical Effects
2. Social/Recreational/Experiential Effect
3. Social/Political Effect
4. Health/Safety Concern
5. Economical/Timing Consideration
6. Wilderness character/resource effects.

| | |
|---|---|
| 7 | **SELECT AN APPROPRIATE PREFERRED ALTERNATIVE** *(provide justification below)* |

List Preferred Alternative and Provide Justification: Preferred Alternative: Saguaro NP will use an integrated, proactive approach to control exotic plant species by selecting the most effective treatment for that species and location (i.e. adaptive management). The plan and control work would begin upon completion and approval of the environmental and cultural compliance documentation and would have a sunset date of 8 years. During the first three years of the plan, large infestations of buffelgrass and fountain grass would be treated. One of the methods of control involves the use of string trimmers to remove standing biomass followed by herbicide application after the plant greens up. This allows the herbicide application to be more effective and returns the plant cover levels to pre-exotic plant infestation levels, which will enhance native plant restoration. The use of string trimmers may have negligible adverse effects on native plants and wildlife. Mitigations are described in the Exotic Plant Management Plan that would remove or minimize the potential adverse effects. The wilderness users' experience may be adversely impacted during the use of string trimmers (due to noise).

This will be minimized by limiting the use of string trimmers to patches that are larger than 0.10 acres and only using the string trimmers during specific time periods (Nov. or Dec. and June or July). The buffelgrass and fountain grass are only found below 4,500 feet elevation and typically in remote locations, which also further limits the number of visitors that will be impacted (at the RMD, off-trail travel is prohibited below 4,500 feet). A safety plan is included in the Plan and job hazard analyses have been developed for all aspects of this work, therefore impacts to employee health and safety will be negligible. If a hand-tool method was used instead of string trimmers (i.e. machete), there would be a greater risk to employee safety. Visitor health and safety will not be impacted by the use of string trimmers. See the Plan for further information on health, safety, economics, timing, etc.

Signatures:

Danielle Foster — Requester — Date: 11/5/04

Margaret Wilkerson — Reviewed By (Division Chief) — Date: 11/5/04

Reviewed By (Chief Ranger) — Date: 11/5/04

Approved by (Superintendent) — Date: 11/5/04

# APPENDIX C

# SAFETY PLAN

***HERBICIDE SAFETY AND SPILL PLAN***

The following information will be reviewed by all workers who handle herbicides.

- All personnel who handle herbicides will obtain a Pesticide Applicators License from the Arizona Structural Pest Control Commission with licensing in the category of 'Right of Ways and Weed'.
- All potential herbicides to be used in the park are described in the Exotic Plant Management Plan and Environmental Assessment. Before those herbicides are used in the park, yearly approval will be obtained from the NPS Regional IPM coordinator through the NPS Pesticide Use Proposal System (PUPS).
- All personnel will be familiar with and strictly adhere to the mitigation measures described in the Exotic Plant Management Plan (in Chapter 2).
- Safety equipment will be carried by all employees in the field (first aid kits, PPE). Communication equipment (cell phone and/or radio), herbicide labels, and MSDS will be carried by a minimum of one person in each field crew.

**Information and Equipment**

A copy of the Labels and Material Safety Data sheets for herbicides being used will be available at all times during project operations. All personnel involved in the handling of pesticides will review and be familiar with relevant Material Safety Data Sheets.

Required Personal Protective Equipment (PPE) will be worn at all times when herbicides are being mixed and applied. Label requirements for specific herbicides will be followed. Applicators and handlers must wear the PPE required by the labels of each herbicide being applied.

An emergency spill kit, with directions for use, will be available when herbicides are being mixed, transported and applied. Employees will be trained in the use of the spill kit prior to initiation of operations. The spill kit will contain the following equipment:

- Shovel
- Broom
- Absorbent material
- Large plastic garbage bags
- Safety goggles
- Rubber gloves

**Procedures for Mixing, Loading and Disposing of Chemicals**

The following procedures will apply to all herbicide applications:

1. Mixing of herbicides will occur at least 100 feet from well heads or surface waters.
2. Dilution water will be added to the spray container prior to addition of the spray concentrate.
3. Hoses used to add dilution water to spray containers will be equipped with a device to prevent back-siphoning, or a minimum 2-inch air gap.
4. Only those quantities of herbicides needed for one day's use will be mixed.
5. Those workers mixing chemicals will wear personal protective equipment required by the label.

6. Empty containers will be triple rinsed. Rinsate will be added to the spray mix or disposed of at the application site at rates that do not exceed those on the label.
7. Unused herbicides will be stored in a pesticide storage cabinet in accordance with herbicide storage instructions provided by the manufacturer and in accordance with Arizona Structural Pest Control Commission Regulations.
8. Empty and rinsed herbicide containers will be punctured and disposed of according to label directions.

**Procedures for Herbicide Spill Containment**

In the event of a spill, immediately notify the project supervisor. Identify the nature of the incident and extent of the spill, including the product name(s) and chemical registration number(s).

Remove any injured or contaminated person to a safe place. Remove contaminated clothing and follow MSDS guidelines for emergency first aid procedures following exposure. Obtain medical help for any injured employee.

**Minor Spills (Less than 1 gallon of herbicide formulation or less than 10 gallons of herbicide mixture).**

Areas where chemicals are spilled will be roped off or flagged to warn people and restrict entry. Qualified personnel will always be present on the site to confine the spill and warn of danger until it is cleaned up. The spill will be confined with earthen or sand dikes if the chemical starts to spread. The spill will be soaked up with absorbent material such as sawdust, soil, or clay. Contaminated material will be shoveled into a leak proof container for disposal and labeled. Contaminated material will be disposed of using the same method as for herbicides. The spill area will not be hosed down. Emergency phone numbers will be carried by the herbicide applicators.

**Major Spills (More than one gallon of herbicide formulation or more than 10 gallons of herbicide mixture).**

Areas where chemicals are spilled will be roped off or flagged to warn people and restrict entry. Qualified personnel will always be present on the site to confine the spill and warn of danger until it is cleaned up. The spill will be confined with earthen or sand dikes if the chemical starts to spread. The spill will be soaked up with absorbent material such as sawdust, soil, or clay.

The local fire department and State pesticide authorities will be notified. Follow their instructions for further action. Whenever possible, someone familiar with the situation will remain at the site until help arrives. Emergency phone numbers will be carried by the herbicide applicators.

Decontaminate the soil by removing it to a depth of at least 2 inches below the contaminated zone and place in clearly labeled leak proof containers for disposal.

**Reporting**

The following list is a guide for the information regarding spills that should be reported. Incidents should be reported even if there is doubt as to whether the spill is an emergency or whether someone else has reported it. Emergency phone numbers will be carried by the herbicide applicators.

Date:
Time of Release:
Time Discovered:
Time Reported:
Duration of Release:

Location: (State, county, route, milepost)
Chemical name:
Chemical identification number:
Chemical data:
Known health risks:
Precautions to be taken:
Cause and source of release:
Estimated quantity (gallons) released:
Quantity (gallons) which has reached water:
Name of affected watercourse:
Number and type of injuries:
Potential future threats to environment or health:
Your name:
Telephone numbers:
Address:

## *GENERAL SAFETY*

It is essential that safety be a part of every employee's job. Because of the varied terrain, elevation, variable and often severe weather, number of visitors, and a variety of work performed, employees and visitors face a myriad of potential natural and manmade hazards. Everyone needs to exercise caution on and off duty to ensure that this year will be a safe and enjoyable one. Remember: THERE IS NO JOB OR TASK WHICH IS SO IMPORTANT THAT REQUIRED TIME AND RESOURCES CANNOT BE DEDICATED SO THAT IT MAY BE PERFORMED SAFELY.

In the event of an injury, immediately notify the supervisor or crew leader and seek medical attention if needed. The required forms related to workplace injuries will be carried in the field at all times by at least one member of the field crew (typically the crew leader). In the packet with the forms will be directions to nearest medical facilities, emergency notification phone numbers, radio call numbers, and procedures to follow in case of emergency. All crew members will be provided a basic first aid kit and this will be carried at all times in the field.

Job hazard analyses have been developed for all aspects of exotic plant control work (hand-pulling, string trimming, herbicide application). In addition, general environmental safety guidelines have been developed. These documents are available on the park network and in the Restoration Program files. The Restoration Program will conduct weekly safety meetings to discuss safety concerns, review herbicide labels, MSDS, and application procedures, and other applicable topics.

The following are some of the typical hazards employees can expect to encounter at Saguaro NP:

### HEAT EMERGENCIES

At Saguaro National Park, heat emergencies (particularly dehydration) are our biggest problem for both visitors and employees. Heat emergencies are serious and potentially fatal conditions typically brought on by exposure to heat combined with dehydration. Early symptoms include headaches, nausea, muscle spasms, and fatigue. More advanced cases (heat exhaustion to heat stroke) include symptoms of cool moist skin, dilated pupils, fever, dark urine, dry hot and red skin, confusion or irrational behavior, unconsciousness. Always wear sunscreen, a hat, and lightweight clothes, drink plenty of water (in summer at least one quart per hour for light to moderate activity), and eat snacks or drink an electrolyte solution to replace electrolytes lost during sweating. If you are thirsty, you are already dehydrated and need to increase your fluid consumption. Alcohol and sodas are diuretics, so avoid them when working outdoors in the heat.

### LIGHTNING

Afternoon thunderstorms are frequent in the summer monsoon season. When thunderstorms approach, avoid mountain tops, exposed areas, tall or lone trees, ponds or puddles. If lightning is nearby, refrain from transmitting on portable radios. If caught in the open when lightning is imminent, squat with hands on knees, keep your head low and wait for the storm to pass. If carrying a metal frame backpack, remove it and place it away from you. Lightning has caused several injuries and deaths in the Tucson area and should not be taken lightly.

### WEST NILE VIRUS

The West Nile virus (WNV) is transmitted to people by bites from infected mosquitoes. The virus is maintained in the bird-mosquito-bird cycle. Mosquitoes are infected by feeding on a bird with virus in its blood. Humans are infected when an infected mosquito bites them. Person-to-person transmission does

not occur. The virus is relatively new to Arizona, but has the potential to be prevalent whenever mosquitoes are abundant. At the lower elevations this can be from March to November, or longer.

Most people who are infected with the virus do not become ill and have no symptoms. For persons who do become ill, the time between the mosquito bite and the onset of symptoms ranges from 5-15 days. Two types of disease occur in humans: (1) viral fever syndrome, and (2) encephalitis, an inflammation of the brain. Symptoms of the viral fever syndrome include fever, headache, and malaise. These symptoms persist for 2-7 days. Encephalitis is very rare. Symptoms include a sudden onset of high fever and a headache, and them may progress to stiff neck, disorientation, tremors, and coma. There is not specific treatment for this virus except supportive care.

To decrease exposure to mosquitoes and the West Nile virus:

- Limit outside activity around dawn and dusk when the mosquitoes feed.
- Wear protective clothing such as lightweight long pants and long sleeve shirts when outside.
- Apply insect repellant to exposed skin when outside. Repellents with DEET are the most effective.
- Make sure that doors and windows have tight-fitting screens. Repair or replace screens that have tears or holes in them.
- Drain all standing water on property, no matter how small an amount.
- Remove items that could collect water such as old tires, buckets, empty cans, and food and beverage containers.

HANTAVIRUS

Hantavirus Pulmonary Syndrome (HPS) is a disease caused by a virus that is carried by rodents, particularly the deer mouse. Hantavirus is present in the saliva, urine and feces of infected mice. People are infected by breathing in the virus during direct contact with rodents or from disturbing dust and feces from mice nests or surfaces contaminated with mice droppings or urine.

There have been few cases of HPS reported in Arizona, however, the consequences of HPS can be severe; approximately half of the people who develop HPS die.

SPIDERS (BROWN RECLUSE AND BLACK WIDOW)

Two venomous spiders are found here, the brown recluse and the black widow. Both types of spiders have bitten employees and volunteers in past years. Please use caution when entering dark spaces in or under buildings. Little-used out buildings (like sheds) are likely hiding places.

- The brown recluse spider is typically a dark brown to almost black spider with a characteristic violin-shaped mark on the spider's back. The bite from this spider causes a stinging sensation followed by intense pain. Within 24 to 36 hours, the victim may experience fever, chills, nausea, weakness, and joint pain. The venom kills the affected tissue, which sloughs off and exposes the underlying tissue. Healing can take 8 weeks or longer.
- Red "hourglass" markings on the lower abdomen of a shiny black body distinguish the black widow spider. These spiders spin tangled webs of coarse silk in dark places. The bite may or may not be painful. Afterward, red swelling and possible numbness may be evident in the bite area. Some people are allergic to spider venom and those victims will experience additional muscle-related symptoms (cramps, tremors, etc).

If you have been bitten by a brown recluse or a black widow spider, it is recommended that you seek medical attention.

AFRICANIZED HONEY BEES (AHB)

An Africanized honey bee is a hybrid between non-native domesticated strains of the European honey bee and an African strain accidentally released in Brazil in 1957 that has slowly migrated north. It is estimated that 99% of the honey bee colonies in Saguaro are Africanized. The Africanized honey bees are very difficult to distinguish from their European counterparts, except through their aggressiveness. AHB's aggressively defend established colonies, but rarely attack when foraging or swarming. Africanized honey bee stings are not different from the European honey bees in the potency of their venom. The difference lies in the intensity, duration, and persistence of attack, with the Africanized honey bees at the high end of the spectrum.

Do's and Don'ts:

- Look out for honey bee colonies when outdoors
- If you find a colony of bees, leave them alone and report the colony (see below)
- Wear light colored clothes
- Avoid wearing scents of any kind when hiking
- Be particularly careful when using equipment that produces sound vibrations
- Keep escape routes in mind
- If you know you are allergic to bee stings, always carry a bee sting kit and have someone with you when doing outdoor activities (make sure that person knows you are allergic and where your kit is located, in case of emergency)
- If you are attacked, RUN!! Use a sting shield to allow you to protect your head from further stings while running (your supervisor should provide a sting shield and training)
- Once you have reached shelter or outrun the bees, remove all stingers by scraping them out

To report Africanized honey bee activity, take the following information:

- Specific location of bees (GPS coordinates if possible)
- Numbers observed (single bees, group, swarm)
- Activity observed (foraging, drinking, moving or resting swarm, defensive, or attacking)
- If an established colony was seen (in a hole, crevice, tree, saguaro, rocks, ground, etc.)

Forward reports of suspected AHB activity to Resources Management, Visitor and Resource Protection, and the Integrated Pest Management Coordinator. Personnel will inspect the reported area, locate the established colony, and determine what the colony is (Africanized honey bees, European honey bees, wasps, flies, or native bees). The park has an Africanized Honey Bee Action Plan that outlines and implements a strategy for addressing safety concerns associated with AHBs at Saguaro NP.

SCORPIONS

Scorpions are very common in the Sonoran desert. Scorpions are active at night; during the day they hide under stones and tree bark, in rock and wood piles, and in masonry cracks. Use caution when moving rocks, logs, etc. Don't put your hands or feet where you can't see. Shake out boots and shoes before putting them on. Scorpion stings are painful, but are rarely dangerous (except bark scorpions). People who are sensitive to insect stings may be more likely to have a reaction to scorpion stings.

CONE-NOSED BUGS (KISSING BUGS)

The cone-nosed or kissing bugs are commonly found at the lower elevations in the summer months, especially May, June and September. They are nocturnal insects and feed on warm-blooded animals, particularly packrats. When the preferred host is unavailable, they will locate the next best thing (human, dog, etc.). The bite of the kissing bug usually is painless because the mouthparts are very sharp and big enough for only a single blood cell to flow through. Many people will only develop a welt like a mosquito

bite. Some people react more adversely, developing hives or in extreme cases, experiencing an anaphylactic reaction. It has been reported that people being bitten a lot may develop the more adverse response to the bites over time.

Prevention: Do not camp near packrat nests. Use tents when camping in areas that may have kissing bugs. Check your tent for insects before sleeping. Remove any insects that you locate. Insecticides are really not useful in fighting cone-nosed bugs. The best control method is to remove any individuals you find, and avoid camping in areas that are more likely to have high populations of kissing bugs.

VENOMOUS REPTILES (RATTLESNAKES AND GILA MONSTERS)

Six different species of rattlesnakes live in Saguaro National Park. They are found at all elevations in the park, from the desertscrub community to the ponderosa pine forests of the Rincon Mountains. Like the name implies, the rattlesnakes have a rattle at the end of the tail. Don't count on getting a warning rattle every time you encounter a rattlesnake. Even if a snake feels threatened by your presence, it may not rattle. Snakes generally want to be left alone and prefer to stay hidden and avoid confrontation.

A rattlesnake will generally bite for one of two reasons: to inject venom into its prey, or in self defense. Most rattlesnake bites to humans are because the rattlesnake felt threatened by the human's actions. However, occasionally the victim did not intentionally provoke the snake into biting. In about 25% of all rattlesnake bite cases, the snake does not inject venom. To reduce your chances of being bitten by a snake, follow these simple guidelines. Do not harass or attempt to kill snakes. If you see a snake, stay at least 4 feet away from it. Do not put your hands or feet where you can't see. Wear boots and loose fitting pants while hiking and carry a flashlight after dark.

If you are bitten by a snake, seek emergency medical treatment immediately. Do NOT attempt to treat a snake bite yourself. Many of the treatments cause more damage than the snakebite itself (never make incisions, use ice, or electricity).

Gila monsters are the only venomous lizard in the continental United States. Like snakes, they generally want to be left alone and prefer to stay hidden and avoid confrontation. If you encounter a Gila monster do NOT pick it up. The bite of a Gila monster differs in method of injection and type of toxin, but the bite of a Gila monster is just as dangerous as the bite of a rattlesnake. The Gila monster bite tends to be fast-acting and the victim will go into shock quickly. Gila monsters are not aggressive animals, so if you don't handle it, you won't get bitten! Keep in mind the same safety precaution as for rattlesnakes: Do not put your hands or feet where you can't see.

# APPENDIX D

## HERBICIDES PROPOSED FOR USE IN THE SAGUARO NP EXOTIC PLANT MANAGEMENT PLAN

Note: Marker dyes and surfactants may be used in conjunction with the following herbicides. Marker dyes are mixed with herbicides to make them more visible. Higher visibility of herbicides allows applicators to more effectively protect themselves from contamination; and also provides a means to prevent unintended multiple applications, wind-blown overspray, and spraying of non-target plants. Surfactants (mineral oil, vegetable oil, or others) are sometimes used to increase the efficacy of herbicides, and will only be used in accordance with herbicide label recommendations.

EPA Toxicity Levels: I = highly toxic; II = moderately toxic; III = slightly toxic; IV = almost non-toxic.
Toxicity examples: Aspirin = III; Caffeine = II; Sugar = IV

Herbicides listed in alphabetical order. **Glyphosate and triclopyr will be the most commonly used herbicides under this plan and EA.**

**Herbicide: 2,4-D Amine or 2,4-D Ester**
**Brand name (examples): Aqua-Kleen, Weedone, Barrage** and others
**Behavior in Soil/Air:** This herbicide degrades quickly, with an average half-life in the soil of 10 days. Degradation occurs through microbial metabolism. Leaching/mobility is minimized by rapid breakdown in soil and by effective plant uptake. Volatilization can be a problem (i.e. affecting non-target plants) and should be minimized by using amine (salt) formulations or low-volatile esters. Risk of volatilization increases with higher temperature and moisture.
**Impact to Plants:** A selective, foliar-applied herbicide that mimics the growth hormone auxin, causing uncontrolled growth and subsequent death of plants. 2,4-D targets annual and perennial broadleaf plants (dicots). Repeated applications may be necessary because of the herbicide's short half-life.
**Impact to Non-Target Species:** Little to no activity against grasses and other monocots.
**Riparian/Water Use/Concerns:** Some salt (amine) formulations are labeled for aquatic use; half-life is shorter than 10 days in water. Ester formulations are toxic to fish and aquatic invertebrates: avoid use near water/riparian areas.
**Impact to Human Health:** EPA Toxicity level II. Toxic effects appear to be greater in the ester formulations than in the salt formulations. Nervous system damage has resulted from absorption of 2,4-D through the skin. It may cause eye damage and skin irritation, burning in chest or coughing, so proper PPE is imperative.
**Re-entry time period:** when spray solution has dried.

**Herbicide: Clopyralid**
**Brand name (examples): Reclaim, Transline,** others, also available in herbicide mixes with reduced selectivity.
**Behavior in Soil/Air:** Average half-life of this herbicide is one to two months. Decomposition occurs through microbial metabolism. Because it is not readily adsorbed by soil particles, clopyralid has the potential to be highly mobile in soil. Avoid use in sandy soils and during rainy seasons. Does not readily volatilize.
**Impact to Plants:** A highly selective herbicide that mimics the growth hormone auxin, causing uncontrolled growth and subsequent death of plants. Can be applied to leaves or soil/roots, though foliar

application may be more effective (root application kills roots only, while leaf application kills roots and foliage). Clopyralid is used specifically to target plants in the following families: Asteraceae (composite/sunflower), Fabaceae (legume), Solanaceae (nightshade), Polygonaceae (buckwheat), Violaceae (violet).
**Impact to Non-Target Species:** Little to no activity against grasses, other monocots, and members of the mustard family (Brassicaceae). Relatively non-toxic to mammals, birds, fish and invertebrates.
**Riparian/Water Use/Concerns:** Because of its high leaching potential and persistence, clopyralid should not be used near water or in places where groundwater is near the surface.
**Impact to Human Health:** EPA Toxicity level IV. This herbicide is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. No reports of acute poisoning in humans have been found. Clopyralid can cause severe eye damage, so properly fitted goggles are mandatory for applicators.
**Re-entry time period:** when spray solution has dried.

**Herbicide: Dicamba**
**Brand name (examples): Clarity, Banvel,** others
**Behavior in Soil/Air:** Dicamba has an average half-life of 14 days. It degrades only through microbial metabolism; thus persistence is determined by the amount of microbial activity in the soil. The product is only weakly adsorbed to soil particles and thus has a high leaching potential. No information on volatility is available.
**Impact to Plants:** A selective herbicide that mimics the growth hormone auxin, causing uncontrolled growth and subsequent death of plants. Has similar effects to, but does not penetrate plant tissues as rapidly as 2,4-D.
**Impact to Non-Target Species:** Little activity against grasses and other monocots.
**Riparian/Water Use/Concerns:** Because of its high leaching potential, dicamba should not be used near water or in places where groundwater is near the surface.
**Impact to Human Health:** EPA Toxicity level IV. This herbicide is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. There are no reported cases of long-term health effects in humans due to dicamba exposure.
**Re-entry time period:** when spray solution has dried.

**Herbicide: Glyphosate**
**Brand name (examples): Roundup, Rodeo,** others
**Behavior in Soil/Air:** Glyphosate has an average half life in soil of 47 days. It is rapidly and readily adsorbed to soil, making its mobility/leaching potential low. Since it is bound by the soil, it is generally not absorbed by non-target plants through their roots. Degradation of glyphosate in the soil occurs through microbial metabolism. Rainfall within six hours of application may reduce this herbicide's effectiveness. Does not appear to volatilize.
**Impact to Plants:** A nonselective herbicide applied to leaves, green stems or cut-stumps, glyphosate inhibits amino acid and protein synthesis in plants, with toxic effects. The product is readily translocated to roots through the plant.
**Impact to Non-Target Species:** Glyphosate acts effectively on a wide range of plants; therefore care must be taken to limit adverse effects on non-target plants (overspray/drift being the primary concern during application). Since the same amino acid pathways are not present in animals, glyphosate is considered to be relatively non-toxic to them.
**Riparian/Water Use/Concerns:** Readily adsorbs to sediments in aquatic situations and is relatively non-toxic to submersed plants of itself. However, some adjuvents that are mixed with glyphosate in commercial formulations are highly toxic to aquatic plants and animals. Formulations registered for aquatic use are available.

**Impact to Human Health:** EPA Toxicity level IV. Glyphosate is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. Most reports impacts to humans have involved skin or eye irritation while mixing and loading.
**Re-entry time period:** when spray solution has dried.

**Herbicide: Imazapic**
**Brand name (examples): Plateau, Cadre**
**Behavior in Soil/Air:** Imazapic is relatively persistent in soil, with an average half-life of 120 days. It has low mobility in soil and does not volatilize. Soil adsorption decreases with increasing pH. This product is degraded in the soil primarily by microbial action.
**Impact to Plants:** Inhibits plant production of branched chain amino acids necessary for protein synthesis and cell growth. It is a moderately selective herbicide, acting against a wide variety of annual and perennial grasses and some broadleaf weeds.
**Impact to Non-Target Species:** Relatively non-toxic to amphibians, and to terrestrial and aquatic mammals and birds.
**Riparian/Water Use/Concerns:** Imazapic in aqueous solution degrades fully in one to two days through exposure to sunlight. This renders it relatively non-toxic to aquatic life. However, it is persistent in groundwater; therefore use should be avoided where water tables are near the surface.
**Impact to Human Health:** EPA Toxicity level IV. Imazapic is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. If ingested, imazapic is rapidly excreted in the urine and feces and does not bioaccumulate.
**Re-entry time period:** when spray solution has dried.

**Herbicide: Triclopyr (ester and amine formulations)**
**Brand name (examples): Garlon, Access**
**Behavior in Soil/Air:** Triclopyr has an average half-life in soil of 30 days. Because it is relatively persistent and only moderately adsorbed by soil particles, the product has a moderate potential to move offsite. This risk is mitigated by the fact that triclopyr is primarily used in cut-stump application. It is broken down in soil by a combination of microbial metabolism, sunlight exposure, and hydrolysis. Ester formulations can be highly volatile under hot and/or damp conditions.
**Impact to Plants:** A selective herbicide that mimics the growth hormone auxin, causing uncontrolled growth and subsequent death of broadleaf plants. Triclopyr is most often used for control of perennial woody species.
**Impact to Non-Target Species:** Little to no action on grasses. Relatively non-toxic to terrestrial vertebrates and invertebrates.
**Riparian/Water Use/Concerns:** Amine formulations break down very rapidly in water and are relatively non-toxic to aquatic organisms. Esters persist longer; and some are quite toxic to fish and aquatic invertebrates.
**Impact to Human Health:** EPA Toxicity level III. Triclopyr does not cause birth defects or cancer, and has little or no effect on fertility or reproduction. The exposure levels a person could receive from routine operations are below the levels shown to cause harmful effects in laboratory studies.
**Re-entry time period:** when spray solution has dried.

# APPENDIX E

## SELECTED EXOTIC PLANTS OF SAGUARO NP AND THE BEST KNOWN/MOST COMMON CONTROL METHODS

***Ailanthus altissima***
**tree of heaven****
Tree with prolific root and stump sprouting; not shade tolerant, allelopathic to other trees. Grows from 4500' to 7000'. Best removal method is hand pulling of young saplings before a taproot develops (Hoshovsky 1988). For established trees, cut-stump application of triclopyr is recommended. Other effective herbicides include glyphosate and dicamba (USFS 2003). With all methods, monitor closely for resprouting.

***Alhagi maurorum***
**camelthorn****
Perennial, spiny leguminous shrub, reproducing by seed and primarily from deep vertical roots and rhizomes. Found from 100' to 5000', a serious invader near watercourses in Arizona. Manual control is difficult because of extensive root system. Possible herbicides include 2,4-D, picloram.

***Arundo donax***
**giant reed**
Large, perennial bamboo-like grass. Spreads rapidly vegetatively through prolific shoot production, growing in moist areas and along watercourses up to 4500'. Very small infestations can be removed by hand or with tools with careful attention to remove all root pieces. Larger infestations should be treated with cut-surface application of wetland-approved glyphosate. Treat post-flowering and pre-dormancy (McWilliams 2004, USFS 2003).

***Avena fatua***
**wild oats**
Annual, cool-season grass spread by seed; observed to have strong allelopathic effects in some areas. Found from 2450' to 3700' in the park, but probably much more widespread. Hand/tool pulling is preferred method of treatment. Effective herbicide is glyphosate. Plants and seeds destroyed by fire.

***Brassica tournefortii***
**Sahara mustard**
Winter annual herbaceous species found from 2100' to 3100'. This plant matures before many natives (which may make herbicide application a desirable treatment method), and readily invades low, open areas of the Sonoran Desert, both disturbed and natural. Hand-pulling is the preferred and easiest method of management where a seedbank has not established. Possible herbicides include glyphosate, 2,4-D, dicamba, triclopyr but are apparently untested on this species. Repeat pulling and/or herbicide use as necessary to prevent re-establishment.

***Bromus diandrus***
**ripgut brome**
Annual/biennial/short-lived perennial, cool-season grass reproducing by seed up to 6500'. Hand-pull small infestations. **Note:** *Bromus carinatus* is a native species.

***Bromus rubens***

**red brome**
Annual, cool season grass with rapid spread by seed. Widespread, aggressive invader of open areas in disturbed and undisturbed lands up to 7000'. Annual manual removal (and destruction) of seed heads may reduce small infestations; no records of successful use of herbicides without damage to native plants (Halvorson and Guertin 2003).

***Bromus tectorum***
**cheatgrass**
Annual grass spread rapidly by seed from 2600' to 8600'. Prolific seed producer, adaptable and opportunistic in germination and growth. Can drastically alter near-surface soil moisture regimes as well as fire regimes. Will not compete with deeper-rooted perennials. Hand-pull plants in small infestations, monitor for regrowth. Glyphosate is an effective herbicide. Re-establishment of native perennials (esp. bunch grasses) is essential to provide competition.

***Caesalpinia gilliesii***
**bird of paradise***
Perennial, showy leguminous shrub. A common landscape plant in Tucson. Manual digging should be an effective control method.

***Cenchrus* spp.**
**longspine sandbur**
Annual grass. To 5500'. Mechanical treatment if small population. Consider herbicide use (glyphosate) if pulling causes too much soil disturbance or is ineffective.

***Centaurea melitensis, Centaurea solstitialis***
**Malta starthistle, yellow starthistle****
Winter annual herbaceous species; prolific seed production; spread rapidly. Small seed head formed in the center of rosettes makes mowing ineffective. Viable seed can be produced within eight days of flowering. *C. melitensis* is usually found below 4000', but has been found in Arizona up to 7000'. If introduced, *C. solstitialis* would likely be found at slightly higher elevations. Hand/tool pull to completely remove plant and root, then burn to destroy seeds. If area is too large for effective hand pulling, spot apply herbicides. Effective herbicides are picloram, dicamba, 2,4-D, clopyralid, and glyphosate. Ensure good stand of native species; revegetate if necessary.

***Chenopodium murale***
**nettleleaf goosefoot**
Cool-season, bushy annual herbaceous plant. Prolific seed producer found in disturbed and/or moist areas up to 8000'. Hand-pull small populations and/or apply herbicides (dicamba is effective).

***Cirsium arvense***
**Canada thistle****
Aggressive perennial herb, spreading by seeds and rapidly from spreading roots and root fragments, up to 8600'. Will readily invade undisturbed, natural areas. Hand pulling alone is not effective, as root fragments as small as .2 inches long can produce viable plants. Hand-pulling, mowing, and burning may be effective in combination with herbicide application as a way to increase herbicide susceptibility. Effective herbicides are 2,4-D, dicamba, clopyralid, glyphosate, alone or in mixes. Multi-year monitoring and control efforts will be necessary if plants become established (Zouhar 2001, USFS 2003).

***Cirsium vulgare***
**bull thistle****

Biennial, rosette-forming forb with deep taproot, reproducing only from seed. Plants can survive in rosette stage up to five years. Most problematic in disturbed areas up to 8000', but has colonized some undisturbed natural areas. Cut root below soil surface (i.e. hoe), preferably prior to flowering. Herbicide application in seedling or rosette stage (preferably autumn) can be effective on new invasions. Several biological control methods are available and in use in North America. Clopyralid, dicamba, picloram, 2,4-D, are effective herbicides (Zouhar 2002). Repeated treatment of infested areas will be necessary. **Note:** on-the-ground managers must be able to distinguish this plant from native thistles.

***Cortaderia selloana***
**pampas grass***
Vigorous, perennial tussock-forming grass that produces large amounts of above and below ground biomass, as well as huge amounts of wind-dispersed seeds. Manual removal is labor intensive (root crown must be removed to prevent resprouting), but is the preferred control method for small infestations. Glyphosate is a possible herbicide but is apparently untested (information based on Peterson and Russo, 1988 for related *C. jubata*).

***Cynodon dactylon***
**Bermuda grass**
Perennial, prostrate, turf-forming warm season grass; spreads rapidly from rhizomes and stolons in disturbed mesic areas up to 4700'. Seed production ranges from none to prolific depending on biotype/variety. A combination of manual control (hand/tool removal of rhizomes and stolons), shading/mulching, herbicide application, and establishment of native vegetation is the most effective way to control Bermuda grass. Glyphosate is an effective herbicide in spring or fall, when energy is directed toward rhizome growth. Repeated manual/herbicide treatments will be necessary in treated areas.

***Dimorphotheca sinuata***
**African daisy**
Annual herbaceous weed; escaped landscape plant found from 2250'-4010'. There are no current infestations in the park; and all populations found to date have been small and easily controlled with hand-pulling.

***Echinochloa* spp.**
**barnyard grass**
Annual warm-season grasses of moist places, spreading by seeds up to 7000'. Thorough hand-pulling is the preferred method of control. Some species are difficult to control with herbicides; 2,4-D sodium salts may be effective as a post-emergent herbicide. Repeated pulling and/or herbicide treatment may be necessary.

***Eragrostis cilianensis***
**stinkgrass**
Annual, warm-season grass reproducing by seeds, from 2450' to 6000'. Hoe seedlings as recognizable.

***Eragrostis curvula* var. *conferta, E. curvula***
**Boer lovegrass, weeping lovegrass**
Perennial warm-season bunchgrasses, reproducing by seeds, from 2750' to 7500'. Manual removal (including root system) is preferred method for small infestations. Mowing and application of glyphosate may help with larger infestations.

***Eragrostis lehmanniana***
**Lehmann's lovegrass**

Perennial, aggressive warm-season bunchgrass spread rapidly by seed from 2200' to at least 5100'. If found in small populations, hand pull or treat with herbicide (glyphosate or imazapic) and revegetate as needed. Mowing after herbicide application may help to reduce *Eragrostis lehmanniana*, but mowing may increase growth in certain circumstances. Managers must be well-trained in proper identification of *E. lehmanniana* versus native grasses.

***Erodium cicutarium***
**redstem filaree**
Cool-season, annual weed with rapid spread. A very common weed that habits both disturbed and undisturbed, open sites in the Sonoran Desert up to 8000'. Germination occurs earlier than many species. Hoe/pull plants before flowering. Effective herbicides include 2,4-D, dicamba, glyphosate, and should be applied in the germination stage (usually autumn).

***Euphorbia esula***
**leafy spurge****
Aggressive perennial forb reproducing from seed and from extensive rhizome and root systems. If introduced, the species would most likely succeed in the middle to upper elevation ranges of the park. Picloram and 2,4-D are effective herbicides; several biological controls are available and have been effective in combination with herbicides (Simonin 2000).

***Euryops subcarnosus***
**sweet resinbush****
Low growing perennial shrub; reproduces by seed, expands slowly at first and then rapidly, replaces native vegetation. Primarily known to invade middle-elevation grasslands in Arizona, there are small populations in Sabino Canyon. Most effective treatment would likely include burning, pulling, and application of herbicides (picloram or clopyralid).

***Hordeum* spp**.
**wild barley**
Annual, winter-spring flowering grasses reproducing by seed. Invader of disturbed and undisturbed lands from 2250' to 4350' (and probably higher), with ability to grow on compacted and degraded soils. Has been effectively controlled through prescribed fire in California. Mowing is of questionable effect. Possible effective herbicides include glyphosate.

***Lactuca serriola***
**prickly lettuce**
Winter annual/biennial herbaceous species; reproducing by seed. Prolific seed producer with long taproot, found from 2600' to 7400'. Pull/hoe seedlings before seed set. Potential herbicides include 2,4-D, dicamba, glyphosate.

***Malva parviflora***
**little mallow**
Annual/biennial/short-lived perennial herbaceous species reproducing by seed. Will flower almost year-round; produces long, tough taproot. 2400'-4700'. Young plants can be hand-pulled or treated with glyphosate before taproot develops. Older plants can be hoed below the crown.

***Marrubium vulgare***
**horehound**
Cool season, perennial herb reproducing by seed. Successful invader of degraded areas up to 8000'. Hand pull/hoe small infestations before seed set. Fire kills mature plants and reduces seed bank, and can

be effective with follow-up treatment of post-fire germination. Potential herbicides include 2,4-D. Revegetate if necessary.

***Melilotus* spp.**
**sweetclover**
Common annual/biennial, cool-season herbaceous species. Reproduces by seeds up to 5000'; deep taproot. Small infestations can be hand-pulled. Mowing and fire treatments may encourage or discourage *Melilotus* depending on season and local conditions. 2,4-D is effective primarily on very young emergent plants; other effective herbicides include picloram, clopyralid, dicamba.

***Nerium oleander***
**oleander**
Woody shrub. No documentation of previous control efforts has been found, but because of similarity to other species, cut-surface application of herbicide (triclopyr) may be recommended. Follow-up treatments may be necessary.

***Nicotiana glauca***
**tree tobacco**
Perennial, evergreen shrub or tree; flowers year round and reproduces by seeds. Can produce large amounts of biomass with little moisture on poor soils; found from 2450' to 2600'. Halvorson and Guertin (2003) lists no control methods or management strategies.

***Opuntia engelmannii* var. *linguiformis***
**cow's tongue prickly pear**
Cactus native to central Texas, common cultivar in the Tucson area. Hybridizes with other *Opuntia* species. Found up to 2870' in the park. Mechanical removal is preferred method of treatment.

***Oxalis stricta***
**yellow woodsorrel**
Cool-season, annual to perennial herb; spread primarily by seed, but reproducing from rhizomes in established populations from 2500'-6000'. Native to the eastern United States. Best control is through hand-pulling and mulching during first 6 weeks of growth, before seed production. Roots must be removed or regeneration can occur from rhizomes. Generally resistant to post-emergent herbicides.

***Panicum antidotale***
**blue panicgrass**
Warm-season, short-lived perennial grass of low-elevation moist areas; spread by seed and persisting by rhizomes. Little information available on control methods; those used on Johnson grass may be successful. Resistant to fire.

***Paspalum dilatatum***
**Dallis grass***
Perennial grass of moist places at lower elevations, reproducing only by seed (Parker 1972). Manually remove small infestations; glyphosate is an effective herbicide (TDPIWE 2002).

***Pennisetum ciliare***
**buffelgrass**
Perennial grass with moderate spread by seed and slow spread vegetatively. An invasive plant from 2200'-4350'. Small populations (<25 plants) can be treated mechanically (hand/tool pulling). Glyphosate and triclopyr can be successful when applied during the growth stage; pre-herbicide mowing may have some benefits.

***Pennisetum setaceum***
**fountain grass**
Perennial grass with moderate spread by seed; generally does not spread vegetatively; there are non-seed producing cultivars. 2100'-4600'. Hand/tool pulling recommended for very small populations (<25 plants). Effective herbicides are 2,4-D, triclopyr, glyphosate. Repeat pulling and/or herbicide use as necessary to prevent re-establishment.

***Pentzia incana***
**pentzia****
Perennial shrub. Wild populations are apparently limited to the Pinaleño Mountains. Information on reproductive strategies and elevation distribution is unavailable. Most effective treatment will likely include burning, pulling, and herbicides (picloram and clopyralid; USFS 2003).

***Phalaris canariensis***
**annual canarygrass**
Annual cool-season grass reproducing by seed, growing up to 4600'. Little information on control methods is available; glyphosate is listed as a potential herbicide.

***Polypogon monspeliensis***
**rabbitfoot grass**
Annual grass spread by seed, found in moist areas from 2450' to 8000'. Hand-pull and destroy plants in small infestations. No wildland control methods listed by Halvorson and Guertin (2003).

***Rhus lancea***
**African sumac**
Tree or woody shrub, common Tucson landscape tree found from 2450'-2550'. No documentation of previous control efforts has been found, but because of similarity to other species, cut-surface application of herbicide (triclopyr) may be recommended. Hand/mechanical pulling of small trees is possible. Follow-up treatments may be necessary.

***Rumex crispus***
**curly dock**
Perennial leafy herbaceous species with deep taproot, spread primarily by seed but also reproducing from root fragments. Flowers May-October, dying back to root in winter. Colonizes open areas up to 8000'; does not compete well until taproot is established. Hand-digging must be intensive and thorough to remove taproot; generally not recommended. Repeated clipping/mowing has been successful. Effective herbicides include 2,4-D, glyphosate, dicamba, triclopyr, clopyralid.

***Salsola* spp.**
**Russian thistle, tumbleweed**
Annual, warm-season herbaceous weed of disturbed areas from 2100' to 5450' in the park. Prolific seed producer. Consider treatment only if area will be continually disturbed by natural processes. Consider herbicide use (glyphosate) before flowering if pulling causes too much soil disturbance or is ineffective. Use of 2,4-D may actually cause plants to become more vigorous/resistant. Establishment of native perennials (e.g. native bunchgrasses) and/or removal of disturbance is necessary.

***Schismus arabicus, S. barbatus***
**Arabian grass, Mediterranean grass**
Annual, cool-season grasses reproducing by seeds, found up to 4700'. Very common weeds found in sandy, open areas throughout the Southwest. Will readily invade undisturbed land. Small size makes

hand removal impractical and herbicide application difficult. Glyphosate is an effective herbicide. Due to widespread infestations, eradication may not be feasible. **Note:** can be confused with native *Vulpia octoflora*.

***Sisymbrium altissimum***
**tumblemustard***
Tall winter annual or biennial with deep taproot; prolific seed producer. Very successful invader of disturbed areas across the West, especially in the Great Basin. Grows from 5000' to 7000' in Arizona. Removal of disturbance/establishment of native perennials is a priority in areas where this species occurs. Hand-grubbing is an effective method for removing small infestations; 2,4-D is an effective herbicide (Howard 2003).

***Sisymbrium irio***
**London rocket**
Cool season (in Arizona) annual herbaceous species; prolific seed producer. A common, widespread weed from 2100' to 4700'. Effective herbicides are 2,4-D, glyphosate. High degree of infestation may preclude hand pulling as an effective control method.

***Sonchus* spp.**
**sowthistle**
Semi-succulent winter annual species. Reproduces only from seeds. Generally restricted to disturbed sites from 2350' to 4500' in the park. Hand-pull plants in small populations, ensuring complete removal of taproot. Consider herbicide use (herbicidal soap, glyphosate, 2,4-D, clopyralid, dicamba, picloram) if pulling causes too much soil disturbance or is ineffective. Biological control (gall-forming insect) has been approved in Canada.

***Sorghum halepense***
**Johnson grass**
Perennial, warm-season rhizomatous grass; adaptable, prolific seed producer. Spreads rapidly by seed and from rhizomes, primarily in moist, disturbed areas up to 6000'. Hand-pull plants in small populations. Glyphosate is the recommended herbicide for control of Johnson grass in Arizona when mechanical treatment is ineffective. The herbicide should be applied in the fall for maximum control. All control methods will require subsequent monitoring and spot treatment due to the presence of extensive underground rhizomes.

***Tamarix* spp.**
**tamarisk (salt cedar)**
Woody deciduous shrubs or trees; reproducing by seed and vegetatively by layering, sprouting and from root fragments; prolific seed production. Found along drainages from 2100' to 5000' in the park. *T. aphylla* is an evergreen species that reproduces generally only vegetatively and is less invasive. Cut-surface application of herbicide (triclopyr) is recommended treatment. Follow-up treatments may be necessary. Biological controls are in use in the US.

***Taraxacum* spp.**
**dandelion**
Perennial, naturalized weed of disturbed and undisturbed mesic areas up to 8600'. 2,4-D is an effective pre-bloom herbicide (Esser 1993).

***Tribulus terrestris***
**puncturevine, goatshead**

Summer annual, prostrate weed, reproduces from seed. Can potentially spread very rapidly. Can be confused with native *Kallstroemia* species. Found from 2350' to 7000'. Hand-pull or hoe plants in small infestations, collecting and destroying seed heads. Most effective herbicides include dicamba, picloram, glyphosate. Revegetate with native perennials where possible.

* Reported by I&M to be present in the park.
** Potential invasive plant: not currently present in the park.

All references are from Halvorson and Guertin (2003) unless otherwise noted.

# APPENDIX F

## SPECIAL STATUS SPECIES FOUND IN SAGUARO NATIONAL PARK

Arizona Game and Fish Department Heritage Data Management System
Updated January, 2003

| SCIENTIFIC NAME | COMMON NAME | ESA | BLM | USFS | WSCA | NPL |
|---|---|---|---|---|---|---|
| *Rana yavapaiensis* | lowland leopard frog | SC | | S | WSC | |
| *Cnemidophorus burti stictogrammus* | giant spotted whiptail | SC | S | S | | |
| *Gopherus agassizii* (Sonoran population) | Sonoran Desert tortoise | SC | | | WSC | |
| *Accipiter gentilis* | northern goshawk | SC | | S | WSC | |
| *Asturina nitida maxima* | northern gray hawk | SC | S | S | WSC | |
| *Athene cunicularia hypugaea* | western burrowing owl | SC | S | | | |
| *Buteogallus anthracinus* | common black-hawk | | | S | WSC | |
| *Coccyzus americanus occidentalis* | western yellow-billed cuckoo | C | | S | WSC | |
| *Empidonax fulvifrons pygmaeus* | northern buff-breasted flycatcher | SC | | | WSC | |
| *Falco peregrinus anatum* | American peregrine falcon | SC | | S | WSC | |
| *Glaucidium brasilianum cactorum* | cactus ferruginous pygmy-owl | LE | | | WSC | |
| *Strix occidentalis lucida* | Mexican spotted owl | LT | | S | WSC | |
| *Choeronycteris mexicana* | Mexican long tongued bat | SC | S | | WSC | |
| *Corynorhinus townsendii pallescens* | pale Townsend's big eared bat | SC | | | | |
| *Lasiurus blossevillii* | western red bat | | | | WSC | |
| *Leptonycteris curasoae yerbabuenae* | lesser long-nosed bat | LE | | S | WSC | |
| *Macrotus californicus* | California leaf-nosed bat | SC | S | | WSC | |
| *Myotis velifer* | cave myotis | SC | S | | | |
| *Nyctinomops femorosaccus* | pocketed free-tailed bat | | S | | | |
| *Sigmodon ochrognathus* | yellow -nosed cotton rat | SC | | | | |
| *Abutilon parishii* | Pima Indian mallow | SC | | S | | SR |
| *Asclepias lemmonii* | Lemmon milkweed | | | S | | |
| *Boerhavia megaptera* | Tucson Mountain spiderling | | | S | | |
| *Echinocereus fasciculatus* | magenta-flower hedgehog-cactus | | | | | SR |
| *Euphorbia gracillima* | Mexican broomspurge | | | S | | |
| *Lysiloma microphylla* var *thornberi* | feather bush | | | | | SR |
| *Mammillaria thornberi* | Thornber fishhook cactus | | | | | SR |
| *Muhlenbergia xerophila* | weeping muhly | | | S | | |
| *Notholaena lemmonii* | Lemmon cloak fern | SC | | | | |
| *Opuntia kelvinensis* | Kelvin cholla | | | | | SR |
| *Opuntia versicolor* | stag-horn cholla | | | | | SR |
| *Peniocereus greggii* var *transmontanus* | desert night-blooming cereus | | | | | SR |
| *Samolus vagans* | Chiricahua Mountain brookweed | | | S | | |
| *Sisyrinchium cernuum* | nodding blue-eyed grass | | | S | | |
| *Tumamoca macdougalii* | Tumamoc globeberry | | S | S | | SR |

STATUS DEFINITIONS
Arizona Game and Fish Department Heritage Data Management System

**ESA** Endangered Species Act (1973 as amended) US Department of Interior, Fish and Wildlife Service

Listed

- LE Listed Endangered: imminent jeopardy of extinction.
- LT Listed Threatened: imminent jeopardy of becoming Endangered.
- XN Experimental Nonessential population.

Proposed for listing

- PE Proposed Endangered
- PT Proposed Threatened

Candidate (Notice of Review:1999)

- C Candidate. Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA. However, proposed rules have not yet been issued because such actions are precluded at present by other listing activity.
- SC Species of Concern. The terms "Species of Concern" or "Species at Risk" should be considered as terms-of-art that describe the entire realm of taxa whose conservation status may be of concern to the US Fish and Wildlife Service, but neither term has official status (currently all former C2 species).

Critical Habitat (check with state or regional USFWS office for location details)

- Y Yes: Critical Habitat has been designated.
- P Proposed: Critical Habitat has been proposed.

[\N No Status: Certain populations of this taxon do not have designated status (check with state or regional USFWS office for details about which populations have designated status)].

**USFS** US Forest Service (1999 Animals, 1999 Plants) US Department of Agriculture, Forest Service, Region 3

- S Sensitive: those taxa occurring on National Forests in Arizona which are considered sensitive by the Regional Forester.

**BLM** US Bureau of Land Management (2000 Animals, 2000 Plants) US Dept. of Interior, BLM, AZ State Office

- S Sensitive: those taxa occurring on BLM Field Office Lands in Arizona which are considered sensitive by the Arizona State Office.
- P Population: only those populations of Banded Gila monster (Heloderma suspectum cinctum) that occur north and west of the Colorado River, are considered sensitive by the Arizona State Office.

**NPL** Arizona Native Plant Law (1993) Arizona Department of Agriculture

- HS Highly Safeguarded: no collection allowed.
- SR Salvage Restricted: collection only with permit.
- ER Export Restricted: transport out of State prohibited.
- SA Salvage Assessed: permits required to remove live trees.
- HR Harvest Restricted: permits required to remove plant by-products.

**WSCA** Wildlife of Special Concern in Arizona (in prep)

- WC Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (WSCA, in prep). Species indicated on printouts as WC are currently the same as those in Threatened Native Wildlife in Arizona (1988).

# APPENDIX G

## BIOLOGICAL ASSESSMENT/NO EFFECT STATEMENT

The Biological Assessment/No Effect Statement was sent to the US Fish and Wildlife Service on 11/12/2004.